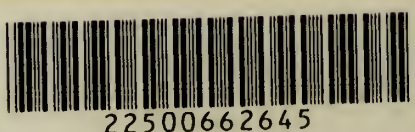

MAYAN CALENDAR SYSTEMS

BY

CYRUS THOMAS

19 ETH, PT 2——9

CONTENTS

ILLUSTRATIONS

MAYAN CALENDAR SYSTEMS.

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PREFATORY NOTES

The recent explorations in Central America and southern Mexico by Maudslay, Holmes, the Peabody Museum, and others have brought to light so much new material that a modification in some respects of conclusions based on the data previously obtained is required. It is expedient, therefore, to bring conclusions and deductions into harmony with the new data. At present, however, attention will be limited to an examination and discussion of the inscriptions and the Dresden codex in the light of this additional material and of the recent discoveries in regard thereto.

That progress toward the ultimate and correct interpretation of these inscriptions and of the codices and symbolic figures will be slow is well understood, and that more or less modification of previous views will follow as the result of new discoveries is to be expected. This fact is well illustrated in the Old World in the efforts of archæologists and linguists to reach a positive and satisfactory conclusion in regard to the so-called Hittite remains.

The most important material for the object of this paper, relating to the inscriptions, is found in the data obtained by Mr Maudslay during his explorations of the ruins of Copan, Quirigua, Tikal, and Palenque. Although the ruins of the last-named place have been described and figured again and again, it was not until Mr Maudslay's clear and large photographs of the inscriptions were published that the data relating thereto—save that on the slab in U. S. National Museum—were in a condition to be satisfactorily studied by those interested in the subject. New light has also been thrown on the inscriptions by certain discoveries made by Mr J. T. Goodman and Dr E. Förstemann in regard to the signification of some of the glyphs.

The positive results so far obtained by attempts to explain the inscriptions and codices, including those obtained by Mr Goodman and Dr Förstemann, relate almost wholly to the time and numeral symbols. In his elaborate and important memoir, Mr Goodman

announces certain discoveries in regard to the signification and use of characters in the inscriptions, which, if verified, will materially modify previous opinions in regard thereto and will bear on future attempts at interpretation of the inscriptions; he also announces other discoveries tending to show that the opinions hitherto held in regard to the Maya time system are erroneous in many respects; and since these announcements form part of Mr Maudslay's great work, Biologia Centrali-Americana, a review of the entire subject would seem timely.

The present paper will be limited to an examination of the time and numeral symbols, time counts and time systems of the Mayan tribes, as indicated by the codices and inscriptions, and will avoid, so far as is possible, rediscussion of points considered as satisfactorily settled previous to the appearance of Mr Goodman's memoir entitled The Archaic Maya Inscriptions (1897). The discussion will be based on a personal examination of the Dresden codex and the inscriptions, the former in Dr Förstemann's photographic reproduction and the latter chiefly in the magnificent photographic (autotype) reproductions by A. P. Maudslay in the archæologic portion of his Biologia Centrali-Americana; but the actual examinations have extended to all the more important Mayan inscriptions in the U. S. National Museum, the Peabody Museum in Cambridge, the collection of the American Antiquarian Society in Worcester, the American Museum of Natural History in New York, and the Museum of Archæology connected with the University of Pennsylvania in Philadelphia.[1] The discussion will be conducted in the light of the recent discoveries, some of which will, as we proceed, appear to be valid and of great importance in the study of Central American paleography. As one object in view will be to test Mr Goodman's interpretations, his work will be used in analyzing the symbols of the inscriptions and the time systems of the Mayan tribes as a basis of comparison in regard to the several points of which it treats. I shall therefore have very frequent occasions to refer to it, not in the spirit of criticism, but simply in behalf of scientific accuracy, as well as of other workers, differing from him where I believe he is wrong and agreeing with him where I believe he is right. The mode of examination will be, so far as possible, by inspection of the glyphs and mathematical demonstration by means of the numeral symbols.

In addition to the objects mentioned as in view in preparing this paper, it is expected that the comparisons and examinations to be made will show to some degree how far the glyphs found at Copan, Tikal, and Palenque, used as time and numeral symbols, agree as to form and signification, and how far they agree in these respects with the characters of the Dresden codex; and will also show whether or

[1] Grateful acknowledgments are made to the officers of these institutions for courteous assistance.

not the same time or calendar system was used in all, and in what respect the system presented by Mr Goodman differs from that generally understood and set forth by other writers—for if he is right in apprehending that previous investigators have been at fault in regard to the Mayan time system, it is important, in view of future investigations, that this be clearly shown and the error be pointed out. A comparison of the time systems of the Maya, Nahuatl, and Zapotec tribes has been made to some extent from the historic standpoint. This comparison indicates that the time systems used by these tribes were substantially the same.

As attention will be given almost exclusively to the examination of the time series and time systems of the codices and inscriptions, it is necessary, in order that the reader may follow closely and apply the tests himself, that the apparatus to be used be placed before him. This will involve some repetition of what has been given in my previous papers; but in order to use Mr Goodman's discoveries in comparisons it is necessary to adopt some scheme of applying them which can be introduced here, as his tables cover more than 100 large quarto pages. This, I have found, can be done, after a little study and practice, by means of two or three short tables, each occupying less than a page. They are therefore inserted with such explanations as are necessary to show how they are to be used. One of these tables which will be used in making comparisons is that numbered 3, on page 21 of my Maya Year, and entitled there "Days and Months of the four Series of Years." It is inserted here as table 1.

TABLE 1—*Days and months of the four series of years*

Akbal year	Lamat year	Ben year	Ezanab year												Days of month
Akbal	Lamat	Ben	Ezanab	1	8	2	9	3	10	4	11	5	12	6	13	7	1
Kan	Muluc	Ix	Cauac	2	9	3	10	4	11	5	12	6	13	7	1	8	2
Chicchan	Oc	Men	Ahau	3	10	4	11	5	12	6	13	7	1	8	2	9	3
Cimi	Chuen	Cib	Imix	4	11	5	12	6	13	7	1	8	2	9	3	10	4
Manik	Eb	Caban	Ik	5	12	6	13	7	1	8	2	9	3	10	4	11	5
Lamat	Ben	Ezanab	Akbal	6	13	7	1	8	2	9	3	10	4	11	5	12	6
Muluc	Ix	Cauac	Kan	7	1	8	2	9	3	10	4	11	5	12	6	13	7
Oc	Men	Ahau	Chicchan	8	2	9	3	10	4	11	5	12	6	13	7	1	8
Chuen	Cib	Imix	Cimi	9	3	10	4	11	5	12	6	13	7	1	8	2	9
Eb	Caban	Ik	Manik	10	4	11	5	12	6	13	7	1	8	2	9	3	10
Ben	Ezanab	Akbal	Lamat	11	5	12	6	13	7	1	8	2	9	3	10	4	11
Ix	Cauac	Kan	Muluc	12	6	13	7	1	8	2	9	3	10	4	11	5	12
Men	Ahau	Chicchan	Oc	13	7	1	8	2	9	3	10	4	11	5	12	6	13
Cib	Imix	Cimi	Chuen	1	8	2	9	3	10	4	11	5	12	6	13	7	14
Caban	Ik	Manik	Eb	2	9	3	10	4	11	5	12	6	13	7	1	8	15
Ezanab	Akbal	Lamat	Ben	3	10	4	11	5	12	6	13	7	1	8	2	9	16
Cauac	Kan	Muluc	Ix	4	11	5	12	6	13	7	1	8	2	9	3	10	17
Ahau	Chicchan	Oc	Men	5	12	6	13	7	1	8	2	9	3	10	4	11	18
Imix	Cimi	Chuen	Cib	6	13	7	1	8	2	9	3	10	4	11	5	12	19
Ik	Manik	Eb	Caban	7	1	8	2	9	3	10	4	11	5	12	6	13	20

Each month consisted of 20 days, each day having its particular name, as follows: Akbal, Kan, Chicchan, Cimi, Manik, Lamat, Muluc, Oc, Chuen, Eb, Ben, Ix, Men, Cib, Caban, Ezanab, Cauac, Ahau, Imix, Ik. The order or sequence here given was always maintained, though the month did not always begin with the same day, since, according to the peculiar arrangement of the calendar, as used in the Dresden codex and the inscriptions,[1] it might begin with (and only with) Akbal, Lamat, Ben, and Ezanab, as is shown in table 1. If it began with Akbal the second day would be Kan, the others following in the order given; if with Lamat, then Muluc would be the second, and so on; if with Ben, Ix would be the second, Men the third, and so on to Eb, the last; if with Ezanab, Cauac, Ahau, etc., would follow, always in the order given. The first day of the year would therefore necessarily be the first day of the months during that year. As the year was divided into eighteen months of twenty days each (always named and arranged in the following order:

1 Pop	7 Yaxkin	13 Mac
2 Uo	8 Mol	14 Kankin
3 Zip	9 Chen	15 Muan
4 Tzoz (or Zotz)	10 Yax	16 Pax
5 Tzec	11 Zac	17 Kayab
6 Xul	12 Ceh	18 Cumhu),

making 360 days, and five days to make the 365 were added at th end of the 18th month (Cumhu), the names following in proper order it follows as a necessary result that the count in the day series would be thrown forward five days each year. If the year (or month) began with Akbal, the last day of the 18th month would be Ik; counting five days—Akbal, Kan, Chicchan, Cimi, and Manik—would bring us to Lamat, the first day of the next year.

The numbering of the days was peculiar; it did not correspond with the days of the month as we count them, but was limited to 13, followed by 1, 2, etc, up to 13, this order proceeding without variation, thus:

1 Akbal	6 Lamat	11 Ben	3 Ezanab
2 Kan	7 Muluc	12 Ix	4 Cauac
3 Chicchan	8 Oc	13 Men	5 Ahau
4 Cimi	9 Chuen	1 Cib	6 Imix
5 Manik	10 Eb	2 Caban	7 Ik

If the list continued 8 Akbal, 9 Kan, 10 Chicchan, etc., would follow. Hence, it is readily seen that by continuing the series each day name would in the course of time have all the thirteen numerals

[1] It is possible that the inscriptions of the Yucatan peninsula will be found to follow the system of the Troano and Cortesian codices and the codex used by Landa, should any inscribed dates be found.

attached to it. The round is completed in 13 months, as will be seen by table 2.

TABLE 2—*The months, days, and numerals for the year 1 Akbal*

Months	Pop	Uo	Zip	Tzoz	Tzec	Xul	Yaxkin	Mol	Chen	Yax	Zac	Ceh	Mac	Kankin	Muan	Pax	Kayab	Cumhu	Uayeb
Days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Akbal	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10
Kan	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11
Chicchan	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12
Cimi	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13
Manik	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1
Lamat	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	.....
Muluc	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	.....
Oc	8	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10	.....
Chuen	9	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11	.....
Eb	10	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12	.....
Ben	11	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13	.....
Ix	12	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1	.....
Men	13	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	2	.....
Cib	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	3	.....
Caban	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10	4	.....
Ezanab	3	10	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11	5	.....
Cauac	4	11	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12	6	.....
Ahau	5	12	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13	7	.....
Imix	6	13	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	.....
Ik	7	1	8	2	9	3	10	4	11	5	12	6	13	7	1	8	2	9	.....

In giving a date, therefore, instead of giving the day name alone, the day and number both are necessary, thus: 4 Ahau, 3 Kan, 11 Ik, etc. But to complete the date so that it can be located in the 52-year cycle of the Mayas, the "calendar round," as Mr Goodman calls it, or in its proper relative position, it is necessary to have the month and day of the month, thus: 4 Ahau 18 Ceh; that is to say, 4 Ahau, the eighteenth day of the (twelfth) month Ceh. The numbering of the months never changes; that is, Ceh is always the twelfth, Pop always the first, Uo the second, and so on.

As may be seen from what has been stated, the years must begin (under the system here followed) with the days Akbal, Lamat, Ben, and Ezanab, following each other in regular order, and before the possible changes have been completed each must receive the entire 13 numerals; hence it is apparent that the period necessary to cover these changes is 52 years (4×13). If the year begin with 1 Akbal (hence called the year 1 Akbal), it will end (counting 365 days) with 1 Manik. As the next day is 2 Lamat, this will be the first day of the next year (2 Lamat). This year will end with 2 Eb and the next will begin with 3 Ben. This will end with 3 Caban and the next begin with 4 Ezanab.

This will end with 4 Ik and the next will begin with 5 Akbal, and so on until the number 13 is reached, when the count begins again with 1. The order in which the years follow one another through a complete cycle of years, or calendar round, is shown in the annexed table (3).

TABLE 3

Akbal	Lamat	Ben	Ezanab
1	2	3	4
5	6	7	8
9	10	11	12
13	1	2	3
4	5	6	7
8	9	10	11
12	13	1	2
3	4	5	6
7	8	9	10
11	12	13	1
2	3	4	5
6	7	8	9
10	11	12	13

This is to be followed in the order of the numbers, 1, 2, 3, 4, 5, etc. As all the possible changes are completed in a cycle of years, or calendar round (we use the term "cycle of years" to distinguish it from the period to which Goodman has unfortunately applied the name "cycle," which is not the same as the 52-year period, which he calls "calendar round"), it always begins or is supposed to begin with 1 Akbal, 1 Lamat, 1 Ben, or 1 Ezanab, according to the order or system adopted, and ends with the year 13. According to the system adopted here it always begins with 1 Akbal.

It is stated above that these tables apply to the "system adopted here." For the benefit of those not thoroughly familiar with this subject an explanation is necessary. As the Maya calendar is an orderly rotation of days, months, and years subject to the rules above stated, resulting from the numbering by 13, the 20 days to the month, 18 months to the year, and the 5 added days, any 4 days of the 20 days, selected at intervals of 5 in the series, could be adopted as dominical days. For example, it appears from the Troano codex that the people where it was made (supposed to have been those of the peninsula of Yucatan) selected Kan, Muluc, Ix, and Cauac as the dominical days, while the Tzental, with whose system the Dresden codex corresponds, selected (if the count of the days of the month began with 1) Akbal,

Lamat, Ben, and Ezanab. Mr Goodman, however, contends that the dominical days used in the inscriptions were Ik, Manik, Eb, and Caban, but instead of commencing the numbering of the days of the month with 1 and continuing with 2, 3, etc., to 20, he begins the count with 20, following it with 1, 2, 3, etc., to 19. In other words, instead of calling the first day of the month 1, he calls it 20 (these, it must be remembered, are not the day numbers, which never exceed 13, but the numbers of the days of the month). This system is in fact, as will be seen by reference to table 4 (page 745), the same—with one difference, which will be explained hereafter—as using Akbal, Lamat, Ben, and Ezanab as the dominical days; for, as will be seen by this table, Akbal, in Ik years, though by position the second day of the month, is numbered the first precisely as it is in Akbal years in our table 1.

Another point necessary to settle absolutely the system is to know which of the dominical days was placed first in commencing the fifty-two year period—in other words, what was the initial day. In table 3 it has been assumed first, that the years of this period began with 1, which has also been assumed by Mr Goodman, and second, that this first year was an Akbal year; but Mr Goodman holds that according to his system it was an Ik year, which, as has been explained, accords with our Akbal year. He expresses also an opinion that Caban was possibly the initial day.

Although this question does not affect the lower time periods, it is apparent that it does affect the numbering of the years of the fifty-two year period. This subject will, however, be referred to again.

Turning now to our table 1, we will try to make as clear as possible the method of using it so as to avoid the introduction of a multiplicity of tables. The year 1 Akbal written out in full would be as shown in table 2. It will be seen that the five figure columns after the thirteenth—to wit, the fourteenth, fifteenth, sixteenth, seventeenth, and eighteenth, numbering from left to right—are precisely the same as the first, second, third, fourth, and fifth, and that the five added or intercalary days are the same as the first five of the sixth column. As the series continued endlessly in this order, I have eliminated in my table 1 the last five columns and five added days, using the first, second, third, fourth, and fifth, and the first five days of the sixth instead.

In counting forward (by which is meant to the right), if the number of months to be counted is not completed on reaching the last or right-hand column, we go back to the first. If, as is frequently the case, our count is to be backward over past or preceding months, it must then be toward the left, and after reaching the first or left-hand column we go to the right-hand column. In other words, it is a continuous round in whichever direction we are moving, to the right being forward in time and to the left backward.

Suppose we wish to know in what year the date 6 Ahau 3 Zotz—that is, 6 Ahau, the 3d day of the fourth month (Zotz)—falls. Looking to the year columns (table 1), we see that Ahau can be the 3d day of the month only in Ezanab years. Looking along the line opposite running through the figure (or month) columns, we find 6 in the seventh column. As this is in the fourth month, to find the first we must count back (to the left) three columns, which brings us to the column headed by 9 (that is, the column whose top figure is 9); hence our year is 9 Ezanab. Now let us trace this year through by the table and find the first day of the next year. Beginning with the column headed 9, we count to the right nine columns, which brings us to the last; then we go back to the first (left-hand) and count eight. This reckoning brings us to the column headed 11. Counting 5 days down the next column (headed 5), we find that the next—the 6th day of the month—is 10 Akbal, which, as will be seen by our table of years (table 3), is correct. To follow out this year, we must begin with the month column headed 10, as this is the first month (Pop) of the year 10 Akbal.

As any one day can fall on only four different days of the month, as Ahau on the 18th in Akbal years, on the 13th in Lamat years, on the 8th in Ben years, and on the 3d in Ezanab years, a mere inspection of the table will at once detect a date erroneous in this respect. For example, there can be no day Manik on the 3d, 9th, or 16th of the month, etc.

Suppose we wish to find on what date the 600th day counting forward from 7 Cib 4 Mac will fall. Looking at the table (1), we see that Cib can be the 4th day of the month only in Ben years. Running along the line opposite (horizontal line) through the figure columns, we find 7 in the column headed 4. As Mac is the thirteenth month of the year, we must count back thirteen months or columns to reach the first month of the year. Counting back the seven columns to the first (left), we then go to the last (right) and count six columns. This brings us to that headed 11; hence the year is 11 Ben, and the next year must be 12 Ezanab. As 7 Cib 4 Mac is the 4th day of the thirteenth month, there will remain of this month 16 days, 5 whole months (100 days), and the added 5 days to complete the year, or, in other words, 121 days. Subtracting this from 600, there remain 479 days to be counted, and deducting from this 365 days, or one year, 114 days remain to be counted on the next year, which must be 13 Akbal. As 114 days equal 5 months and 14 days, we begin with the figure column of our table headed 13, and count forward 5 months (including this one), and counting down the next month (column headed 9) 14 days, we reach the figure 9, and opposite it in the Akbal column find the day Cib. The date reached is therefore 9 Cib, 14th day of the (sixth) montl.

Xul, in the year 13 Akbal. Turning to our table of years (3), we see that 11 Ben is the third year in the Ben column, or the eleventh year of the cycle of years, and that 12 Ezanab and 13 Akbal follow. We are thus enabled to correctly locate these dates in the cycle of years. These statements and examples, with the illustrations which follow, will enable the reader to use the tables and to follow the present investigations.

The order in which the characters in the codices and inscriptions are to be read has been fully explained in my previous publications, and so generally accepted that it is unnecessary to explain it here, especially as it is indicated in the quotation from Maudslay's work given immediately below. This author, speaking of the order in which the inscriptions are to be read, says (Biologia Centrali-Americana, Archæology, part 2, Text, November, 1890, p. 39):

> With regard to the order in which the hieroglyphics should be read, Professor Cyrus Thomas has shown, from an examination of the Palenque tablets, that when a single column only of glyphs is met with, it should be read from the top to bottom, and that when there is an even number of columns, the glyphs are to be read in double columns from top to bottom, and from left to right. I myself came to the same conclusion from an entirely independent examination of inscriptions from Quirigua and Copan, and this order is adopted in numbering the glyphs on the following plates.

As I have also shown that this is usually, though not always, the order in which the glyphs of the codices, when in columns, are to be read, a conclusion which is now accepted by all investigators of Maya symbolic writing, we have in this fact one point of agreement between the codices and inscriptions at Palenque, Copan, Tikal, and Quirigua. The use of dots and short straight lines to indicate numerals up to 19 (each dot counting 1 and each short line 5), as in the codices, is also universal in the inscriptions, as is admitted by Mr Maudslay. He has also confirmed my suggestion (Study of the Manuscript Troano, pp. 202–203) that the little loops connected, in certain cases, with these number symbols have no signification. He says (op. cit., p. 39): "There is no reason to suppose that any different system of notation is employed on the sculptured monuments; it was not, however, usual to leave blank spaces when carving the numerals 1, 2, 6, 7, 11, 12, 16, 17 in stone, but to fill up the space thus:  , 1; , 2; , 6;  , 7, etc."

As the ordinary numeral symbols, the dots and lines (which are never used to signify a higher single number than 19), have been so frequently explained and are incidentally referred to in what precedes, I pass to those discovered by Dr Förstemann and Mr Goodman, as I shall have frequent occasion to use them, but will not discuss at this point the general theory presented by the latter, nor his other

supposed discoveries. He follows, as stated above, the order in reading the inscriptions first explained by me, and accepts the interpretation of the ordinary time symbols which has been universally adopted, with the single exception of that found in the Dresden codex, which has generally been explained as the symbol for "naught," or nothing. This will be again referred to hereafter.

Previous to the appearance of Mr Goodman's work, the following discoveries in regard to the numeral and time systems as given in the codices, in addition to what has been already presented herein, had been made and explained: That this symbol  was used, in counting time, to represent the number 20; that this character  , somewhat variable in form, and usually colored red, was used to indicate "naught" or nothing; and that a certain prefix to month symbols, usually in the form of a double circle, thus  , was used to denote 20, signifying, when thus used, the 20th day of the month. It was further ascertained, as may be seen by reference to papers by Dr Förstemann and myself explanatory of time series in the Dresden codex, that the orders of units in counting long periods, the day being the primary or lowest unit, was as follows: 20, 18, 20, 20, 20; that is to say, 20 units of the first order make one of the second order, 18 units of the second order make one of the third order, 20 units of the third order make one of the fourth order, 20 units of the fourth order make one of the fifth order, and 20 units of the fifth order make one of the sixth order. These different units, save those of the first order, were not expressed by specific symbols, but by position, that is, by being placed one above another, as is here shown, the lowest indicating the first, the next above the second order, and so on.

9 units of the fifth order,  , 9 cycles.

9 units of the fourth order,  , 9 katuns.

9 units of the third order,  , 9 ahaus.

16 units of the second order,  , 16 chuens.

0 units of the first order,  , 0 days.

For the purpose of explanation and comparison I have placed to the left of the symbols their equivalents in Arabic numerals, and in the column to the right the equivalents according to Mr Goodman's nomenclature, which will be explained a little further on.

This example is not an arbitrary one, but is taken from plate XXIV of the Dresden Codex, and has been selected because it was explained by Dr Förstemann, so far as the numbers and count are concerned, in 1887 (Zur Entzifferung der Mayahandschriften, 4, 1887). According

to Dr Förstemann the number of days indicated by these numeral symbols as thus placed is 1,364,360, the length of the periods being as follows:

	Days.
1 cycle	144,000
1 katun	7,200
1 ahau	360
1 chuen	20

Now let us test it by Mr Goodman's system, using his own tables (last page of his paper) for this purpose:

	Days.
9 cycles	1,296,000
9 katuns	64,800
9 ahaus	3,240
16 chuens	320
Days	0
	1,364,360

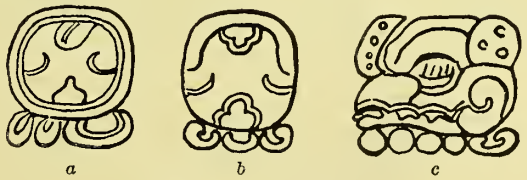
It is evident from this result that this, so far as the system is concerned, is, up to the fifth order of units, precisely that discovered and applied by Dr Förstemann, except as to the "naught" symbol. Even the very order and method of expressing a series which Mr Goodman uses, so far as applicable to the codices, was, as will be seen a little further on, used by Dr Förstemann. In order that I may not do injustice to Dr Förstemann when I speak of the discoveries by Mr Goodman, it is proper to add that not only had he discovered and applied to the time series of the Dresden codex the orders of units accepted and used by Mr Goodman, but had determined as early as 1891 the value of the symbols designated "ahau" and "katun," as appears from his article Zur Maya-Chronologie in the Zeitschrift für Ethnologie for that year. Mr Goodman's paper was not published until 1897, though it is apparent from his preface that it was completed in 1895. If Dr Förstemann had not seen Mr Goodman's paper when his article entitled Die Kreuzinschrift von Palenque, was published in the Globus in 1897—which makes no mention of the former, though referring to works on the subject—it is evident he had discovered independently the value of the symbols which Goodman designates chuen and cycle. To the 360-day period he applied the name "old year" under the supposition that in an earlier stage of their culture the Mayas counted only 360 days to the year; and to the 7,200-day period the name "old ahau." However, it appears from his Entzifferung der Mayahandschrift, number IV, 1894, that as early as June of this year he had calculated correctly the value of some six or eight numeral series on the stelae and altars of Copan from Maudslay's work. This implies necessarily a knowledge of the value of the so-called time periods, and indicates that he had made

this discovery independently, unless he had received some information on the subject from Maudslay of which I have no knowledge. It is apparent from a statement by the latter author in part 2 of his work, published in 1890, that the values of these symbols, save that of the chuen, were yet unknown to him. However, as Dr Förstemann seems to have fallen short of the discovery of their uses and the application of them, the chief credit of the discovery must be awarded to Mr Goodman.

This discovery, which must cancel a number of previous speculations and affect to a large extent all attempts at interpretation of the inscriptions and codices, consists, first, in finding out the fact that in the inscriptions the orders of units above the first, to wit, his so-called chuens, ahaus, katuns, and cycles, were not indicated by position as in the codices, but each had its distinct character or glyph; second, in determining these characters and their values; and, third, in showing from the inscriptions the order in which they are generally arranged and the manner in which the truth of this discovery may be demonstrated. He has also discovered that a certain character, which he terms a "calendar round symbol," was used to indicate the period of 52 years, which has heretofore usually been designated a "cycle" or "cycle of years," and also that certain face characters are used as numeral symbols. As we shall have occasion to use these in our investigation of the inscriptions, the usual forms of the principal ones (using Mr Goodman's names) will be shown here and his other claimed discoveries will be considered hereafter.

The Chuen

This character usually has a numeral symbol on top and at the left side, the former indicating the number of chuens and the latter the added or overplus days.



a *b* *c*

Fig. 8—The chuen symbol.

The Ahau

The numeral indicating the number of ahaus is usually placed at the left.

a *b* *c* *d* *e*

Fig. 9—The ahau symbol.

The Katun

The numeral indicating the number of katuns is usually placed at the left side, though occasionally at the top.

a *b* *c* *d* *e*

Fig. 10—The katun symbol.

The Cycle

The numeral in this case is also usually at the left side.

a *b* *c* *d*

Fig. 11—The cycle symbol.

The Calendar Round

The numeral is usually at the left side.

a *b* *c*

Fig. 12—The calendar round symbol.

The forms of the day symbols usually found in the inscriptions are as shown in figure 13.

The month symbols usual in the inscriptions, including what Mr Goodman claims is the symbol for the five added days or Uayeb, are shown in figure 14.

The typical and usual form of the chuen is shown in the first two glyphs of figure 8 (*a*, *b*). If the number at the top were 3 (three

FIG. 13—The day symbols.

dots or balls), it would signify three chuens or 60 days (3×20); the number at the side if 12 would denote 12 days. It would then read 12 days, 3 chuens, or 3 chuens, 12 days, which together would equal 72 days. This is the only counter or time period symbol which has two numbers attached. It may as well be stated here, to prevent confusion or misunderstanding in regard to our use of terms, that for convenience in our comparisons Mr Goodman's names of these several symbols and the time periods he supposes them to represent will be used, although

I am firmly convinced, for reasons which will be shown hereafter, that they are nothing more than orders of units or multipliers. Therefore, when they are spoken of as "time periods," or by the names given, this must be borne in mind.

The typical and usual form of the ahau is shown in the first three glyphs of figure 9 (*a*, *b*, *c*). This symbol denotes 360 days, which must be multiplied by the numeral—usually at the side—to obtain the full number of days indicated. The name ahau as here used must not be confounded with the day-name Ahau.[1] The use of the same name for two different purposes is unfortunate and confusing.

The usual form of the katun is shown in the first two glyphs of figure 10 (*a*, *b*). The attached numeral, if 1 or 2, is frequently at the top, though usually at the side. As this symbol represents 7,200 days, the number of days indicated is 7,200 multiplied by the attached numeral.

FIG. 14—The month symbols.

The usual cycle symbol is shown by the first glyph of figure 11 (*a*). As the cycle is 144,000 days, 144,000 must be multiplied by the attached numeral to obtain the total number of days.

The great cycle will be referred to hereafter, and the other forms of the chuen, ahau, katun, and cycle will be discussed as the series by which their values are determined are examined.

[1] The day name is always written with a capital, the ahau denoting a period with a small letter.

TIME SERIES IN THE CODICES AND INSCRIPTIONS

The Dresden Codex

As the Dresden codex is now so generally known, it will be made the point of departure and the first examples showing the method of counting time will be taken from it. In this examination further comparison will be made between the system used by Mr Goodman in counting time series and that first made known by Dr Förstemann and used by him and myself in the papers relating to this subject which have been published. As I have somewhat fully illustrated and explained in my Aids to the Study of the Maya Codices (in Sixth Ann. Rep. Bur. Ethnology), a considerable number of the time series of the Dresden codex, in which the figures do not rise above the fourth order of units, the examples referred to here will be those involving high numbers, in order to strengthen the proof of Dr Förstemann's theory and to establish clearly the respective values of the units in the higher orders. These will also necessarily indicate the calendar system in vogue, to which it is desirable to call special attention.

The names of the several orders of units is a matter which failed to receive attention until the subject was taken up by Mr Goodman; those that he has applied are unfortunate and can result only in confusion so long as they remain in vogue. Dr Brinton remarks that "No doubt each of these periods of time had its appropriate name in the technical language of the Maya astronomers, and also its corresponding character in their writing. None of them has been recorded by the Spanish writers, but from the analogy of the Nahuatl script and language, and from certainin dications in the Maay writings, we may surmise that some of these technical terms were from one of the radicals meaning 'to tie, or fasten together,' and that the corresponding signs would either directly (that is, pictorially) or ikonomatically (that is, by similarity of sound) express this idea" (Primer, pp. 30, 31). He suggests *bak* for the 360-day period, and *pic* for the 7,200-day period, and *kal* for the 20-day period. The name chuen, which Mr Goodman has applied to the month equivalent, the 20-day period, was adopted by him because of the resemblance of the glyph to the symbol of the day Chuen. This duplicates the name in the time series. The same objection applies to the names ahau, katun, and cycle; each of these is now applied in three different senses in the calendar system, ahau being used as a day name, as a name of the 24 or 20 year period, and now for the unit of the third order, or 360-day period; katun for the 24 or 20 year period, with ahau prefixed for the 312-year period, and for the unit of the fourth order, or 7,200-day period; and cycle for the 52-year period, also sometimes for the 260-day period, and now for the unit of the

fifth order or the 144,000-day period. Förstemann, as has been already stated, applies the name "old year" to the 360-day period, apparently under the idea that it at some previous time constituted the full year; "old ahau" to the 7,200-day period (a fourth application of this term); and "old katun" to a period of 18,720 days or 52 "old years" ($52 \times 360 = 72 \times 260$). To express 9 cycles, 12 katuns, 18 ahaus, 5 chuens, 16 days, Mr Goodman uses this abbreviation: $9\text{–}12\text{–}18\text{–}5 \times 16$, the $\times$ indicating that the two numbers between which it stands are usually attached to one symbol. Dr Förstemann, as an abbreviation to express the same orders of units, uses the same method, omitting only the $\times$, thus: 10, 19, 6, 0, 8 (Zur Entzifferung der Mayahandschriften, 1887, p. 6).

It will perhaps be as well to insert here what I have to say in reference to Mr Goodman's expressions in regard to, and use of, the term ahau as applied to a time period. The names applied to time periods as a means by which to refer to them are comparatively unimportant, unless such application involves other questions. We quote first the following passage from his work (p. 21):

I now come to what has been a stumbling-block to every one who has hitherto attempted to deal with the Maya records. It has been known that the Mayas reckoned time by ahaus, katuns, cycles, and great cycles, but what was the precise length of any of these periods has been a debatable question. Some have contended, with the best of proof apparently, that the katun is a period of twenty years, while others have maintained, with proof equally as good, that it is a period of twenty-four years. The truth is, it is neither.

The contention arose from a misapprehension, or total ignorance rather, of the Maya chronological scheme. It was taken for granted that a year of 365 days must necessarily enter into the reckoning; whereas the moment the Mayas departed from specific dates and embarked upon an extended time reckoning, they left their annual calendar behind and made use of a separate chronological one.

The use of the term ahau-katun is avoided everywhere in these pages. Such a period never existed, except as a delusion of Don Pio Perez and his misguided followers. The error originated from a misconception of the Yucatec method of distinguishing the katuns. The ahau was numbered according to its position in the katun, as the eighth, tenth, or the sixth from the close; but the katun was designated by the particular number of the day Ahau with which it ended. Thus, for instance, it might sometimes be spoken of as the katun 10 Ahau; and at other times by a mere reversal of the phrase, as the 10 Ahau katun. More frequently, however, the term katun was not used at all, its existence and number being implied by simple mention of the ahau date. But there was no ahau-katun.

On page 23, in speaking of the ahau, he adds:

This period is the real basis of the Maya chronological system. Everything proceeds by ahaus, till in succession the katuns, cycles, great cycles, and grand era are formed from them.

The ahau is a period of 360 days—the sum of the days in the eighteen regular months—and derives its name undoubtedly from the fact that it always begins with the day Ahau. It is the period, not between two Ahaus with the same numeral, but between the second two with a differentiation of four in their day numbering. Moving forward with this progression of four it results that the ahaus follow each other

in the order of 9, 5. 1, 10, 6, 2, 11, 7, 3, 12, 8, 4, 13, 9, 5, 1, and so on—an order of succession that Perez quotes from an unnamed manuscript, but whose significance he failed to grasp.

Twenty ahaus constitute a katun. They are numerated: 20, 1, 2, 3, etc, up to 19.

Finally, in speaking of the katun (p. 24), he says:

It is over this period that the battle royal has been fought. The question of twenty or twenty-four years has raged undeterminedly for more than half a century. As the facts themselves will show the folly of the whole contention, I pass it by without awarding to any individual combatant the discredit of his partisanship.

Twenty years of 365 days make 7,300 days. The katun does not reach that far, falling a hundred days short, as a multiplication of its constituent parts will show: $360 \times 20 = 7{,}200$.

In consequence of the day Ahau beginning the ahaus, it must also begin the katuns; and the ahaus succeeding each other by differences of four, as 9, 5, 1, 10, 6, 2, 11, 7, 3, 12, 8, 4, 13, 9, 5, 1, 10, 6, 2, 11, 7, etc, it results that the order of the katuns, composed as they are of twenty ahaus, must be one in which each succeeding katun begins with a day number two less than its forerunner—thus: 11, 9, 7, 5, 3, 1, 12, 10, 8, 6, 4, 2, 13, 11, etc.

The katuns are numerated in the same manner as the ahaus: 20, 1, 2, 3, etc, up to 19.

Let us examine these expressions so far as they relate to the ahau and bear upon the Maya system as developed in the record.

He says the ahau is a period of 360 days, "and derives its name undoubtedly from the fact that it always begins with the day Ahau." This is undoubtedly the use he makes of it; but was it used by the Mayas in this sense? That he has derived this name as applied to the period of 360 days from the inscriptions appears nowhere in his work. He nowhere asserts or pretends to claim that the symbol denoting this period is in any sense phonetic, giving this name. The only early native authorities to which we can appeal are the Chronicles. To these, therefore, we refer, following Dr Brinton's translation.

In the Chronicle from the Book of Chilan Balam of Mani, the ahaus are numbered over and over again as containing each twenty years. In the thirteenth paragraph (p. 103) it is said "in the thirteenth ahau Ahpula died; for six years the count of the thirteenth ahau will not be ended." It is evident from this, be the count confused and even erroneous, that the author considered the ahau as composed of more than six years. The Chronicle of Chumayel also speaks of the sixth year of the thirteenth ahau, the seventh year of the eighth ahau katun (uaxac ahau u katunil), and the first year of the first ahau katun (ahau u katunile). Another Chronicle of Chumayel expressly makes ahau the equivalent of katun—"the fourth ahau was the name of the katun"—and uses ahau, katun, and ahau katun as synonyms (ahau u katunil).

It is evident from these extracts, be the originals trustworthy or not, that Mr Goodman could not have found therein evidence for his application of the term ahau. Nor can it be obtained from Landa,

who expressly mentions "primero año de la era de *buluc-ahau*." and of the natives doing homage to the various ahaus for ten years each. Mr Goodman's radical error, as we shall see, is taking numerical notation for a time system.

The first example to which attention is called is taken from plate 24 of the Dresden codex, and includes that portion of a long series running up the plate which is shown in our figure 15.

If the order in which the series ascends be that in which it is to be followed, it is evident this must be from right to left, taking the lower division first, thus: D2, C2, B2, A2 (in the lower division), then D1, C1, B1, and A1 (in the upper division). But the plan of the series may be the reverse of this, as it is possible that it runs back in time, and is to be read from left to right the differences between the columns being subtracted instead of added; the result is, however, the same. As there are no month symbols by means of which to determine the years, and our only object in referring to the series is to show the value of the symbols according to the relative positions they occupy in relation to one another, the order in which they are to be read, and the value of the counters, it is not material in which direction the series be taken. We will therefore follow the ascending order—i. e., from right to left, beginning with D2 (right-hand column in lower division). Using Goodman's names, and subtracting D2 from C2 (the ovals which are red in the original being counted as naught) thus:

FIG. 15—Part of plate 24, Dresden codex.

	C2	D2	Diff.
Katuns	4	3	
Ahaus	1	13	8
Chuens	2	0	2
Days	0	0	0

we find the difference to be 8 ahaus, 2 chuens, 0 days. As the day at the foot of the column (D2) is 8 Ahau, without an accompanying month symbol, we may select in our table 1 any 8 Ahau and assign it to any month, as the count will hold good.

For convenience we select 8, the third number in the figure column headed 6, and find Ahau opposite in the Ezanab column. Assuming the month to be Pop, the first month of the year, the year will be 6 Ezanab. As eight ahaus contain 2,880 days, and two chuens 40 days—

together 2,920 days—we subtract therefrom 362, the remaining days of the year 6 Ezanab, thus:

	Days
8 ahaus	2,880
2 chuens	40
	2,920
	362
	2,558

Dividing this remainder (2,558) by 365, we find the number of years to be seven, with an overplus of three days. Looking now to our table of years (3) and counting forward seven years from 6 Ezanab, we reach 13 Ben. As the next year is 1 Ezanab, we look in table 1 to the column headed 1 and count down this to the third day. This brings us to 3, and we find Ahau opposite in the Ezanab column. The day reached is therefore 3 Ahau, which is the day at the bottom of column C2 in our figure 8, showing the count to be correct.

This example, however, involves another question raised by Mr Goodman. It will be noticed that in column D2 of our figure the day place and the chuen place is each filled by an oval figure (red in the original) instead of the ordinary numeral symbols, and that in column C2 the day place is filled by a similar oval figure. In my calculation given above I have counted these as equivalent to ciphers (0), or nothing. Mr Goodman observes (page 64) that a number of persons have declared this to be a sign for naught, adding: "They were led into this mistake, undoubtedly, by its peculiar use and position. It is employed in the codices solely to designate initial periods, and in that position it is the equivalent of 20 in all cases except that of the chuen, where, like the other 20-signs, it denotes but 18." As the example now under consideration affords an opportunity of testing this interpretation, we will do so.

It is apparent from what has been shown that the correct result is obtained by counting these symbols as naught. If the same result be obtained by counting them as signs of full count—that is, 20—or as 18 where filling the chuen place, the test fails to disclose the correct use of them.

Counting the total days in each column and subtracting the sum of D2 from that of C2, the result is as follows:

C2		D2	
4 katuns	28,800	3 katuns	21,600
1 ahau	360	13 ahaus	4,680
2 chuens	40	18 chuens	360
Days	20	Days	20
Total days	29,220	Total days	26,660
	26,660		
Difference	2,560		

Assuming, as before, 8 Ahau, at the bottom of column D2, to be the 3d day of the month Pop in the year 6 Ezanab, we subtract from 2,560 days 362, the remaining days of the year 6 Ezanab. This leaves 2,198, which, divided by 365, gives 6 years and an overplus of 8 days. Counting from the year 6 Ezanab (table 3) 6 years, we reach the year 12 Lamat. The next year will be 13 Ben. Turning to table 1 and counting 8 days down the column headed 13 (as the eighth day from the beginning of the year must fall in Pop, the first month of the year), we reach the numeral 7, and find opposite in the Ben column the day Ahau; hence the day reached is 7 Ahau, and not 3 Ahau, as it should be. The addition of days to the total difference by even twenties will, of course, bring the count back to Ahau, hence the test lies in the number attached to it. It appears, therefore, so far as this example is concerned, that these oval symbols stand for naught, and not for 20 and 18, as inferred by Mr Goodman. It will be observed that the same symbol appears in the other columns of figure 8 copied from plate XXIV, Dresden codex. Positive proof that this oval is used for naught is found on plate 50 of the Dresden codex, which may be seen in plate I of my Maya Year. The oval in the bottom line filling the month or chuen place can reach the required day only when counted as naught, as may be verified by reference to the series of days given in the same work.

In the quotation above from Mr Goodman's work in relation to the red oval symbol which I have counted as naught, he says: "It is employed in the codices solely to designate initial periods." Precisely what he means by this remark I fail to comprehend. When the symbols are found in the same time series in the month place and in the immediately following day place, and then at odd years and months apart in a continuous series, how they can be used to designate initial periods is difficult to understand, unless very short periods are alluded to. That the symbol for no day, or naught, in the day place will indicate the beginning of a month in the count which is to follow is undoubtedly true, and when it is in the month place a new year will follow, and so on. This is also true when 20 days, 18 months, 20 ahaus, etc, are counted. If this be what Mr Goodman means, he is correct; but it is hardly the idea conveyed by his language, which apparently refers to "initial periods," as though of a katun, cycle, or calendar round.

The next column to the left (B2) has 4 katuns, 9 ahaus, 4 chuens, 0 days, and at the bottom 11 ahau. Subtracting from this column the column C2, already given, we have the following result:

	B2	C2	Diff.
Katuns.....	4	4	
Ahaus.....	9	1	8
Chuens.....	4	2	2
Days.....	0	0	0

The remainder, 8 ahaus and 2 chuens, equals 2,920 days, and is precisely the same as the difference between the preceding columns. As the date reached by column C2 was 3 Ahau, the 3d day of Pop, the first month in the year 1 Ezanab, we subtract as before 362, the remaining days of the year 1 Ezanab, from 2,920. This leaves 2,558 days, or 7 years and 3 days. Counting from the year 1 Ezanab (table 3), 7 years, we reach 8 Ben, the next year being 9 Ezanab. Counting down the figure column headed 9 (table 1), 3 days, we reach the numeral 11 and find Ahau opposite in the Ezanab column. The day reached is therefore 11 Ahau, 3 Pop, the first month of the year 9 Ezanab, and corresponds with the day at the foot of column B2 in the plate.

As the difference between column A2 and B2 is precisely the same as that between the other columns (8 ahaus 2 chuens), we have only to count 7 years and 3 days from the close of the year 9 Ezanab. This brings us to the 3d day of the month Pop in the year 4 Ezanab, which we find, by referring to Table I, to be 6 Ahau, corresponding with the day at the bottom of column A2. It must be remembered, however, that the years mentioned have been those following the arbitrary selection for convenience in calculating, as nothing has been discovered in the series to determine these. This could be ascertained if the top series were uninjured, so as to carry on the count to the lower left-hand series, which have definite dates.

Passing now to the upper division of our figure, we notice that the day at the bottom of each column is 1 Ahau and that the day place in each is filled by the oval symbol, denoting, according to our interpretation, naught. As the series ascends toward the left, the columns will be taken in the same order as those of the lower division. We therefore subtract D1 from C1:

	C1	D1	Diff.
Katuns	4	1	3
Ahaus	12	5	7
Chuens	8	5	3
Days	0	0	0

The difference is 3 katuns (=21,600 days), 7 ahaus (=2,520 days), 3 chuens (=60 days), and no odd days. The total is 24,180 days. As the number is large, exceeding a 52-year period or calendar round, we can subtract the greatest possible number of these periods (in this case only one) without in any way affecting the result so far as reaching the proper date is concerned, but the number of years thus embraced are to be counted in making up the true interval between the dates.

As 1 Ahau may be the 3d day of the first month (Pop) of the year 12 Ezanab, we select this as our starting point.

One calendar round equals 18,980 days, which subtracted from 24,180 leave 5,200 days. Taking from this number 362—the remaining

days of the year 12 Ezanab—and dividing the remainder (4,838) by 365, we obtain 13 years and an overplus of 93 days, or 4 months and 13 days. Counting on our table 3, 13 years from 12 Ezanab, we reach 12 Akbal. As the next year is 13 Lamat, we count forward on table 1, 4 months and 13 days. This brings us to 1, the 13th day in the column headed 2, and opposite, in the Lamat column, we find the day Ahau, agreeing with the date at the foot of the column C1 of our figure. The date here is therefore 1 Ahau, the 13th day of Tzec, the 5th month of the year 13 Lamat, according to the assumed initial date.

As the differences between the columns of the upper division of our figure are not the same, a calculation must be made in each case to make the proof positive.

Subtracting column C1 from B1, we find the remainder to be 4 katuns, 18 ahaus, 17 chuens, 0 days, together equal to 35,620 days. Subtracting one calendar round—18,980—there remain 16,640 days. As our last date was 1 Ahau, the 13th day of Tzec, the 5th month of the year 13 Lamat, our count now must be from this date. Subtracting 272—the remaining days of this year—from 16,640 and dividing the remainder by 365, we obtain 44 years and an overplus of 308 days. Referring to table 3 and counting 44 years from 13 Lamat, we reach 5 Lamat. As the next year is 6 Ben, we count 308 days, or 15 months and 8 days, in this year. This brings us to the 8th day of the 16th month (the column headed 7), which we find is 1, and opposite, in the Ben column, the day Ahau, which agrees with the plate. The date therefore is 1 Ahau, the 8th day of Pax, the 16th month of the year 6 Ben.

Subtracting column B1 from A1, we find the difference to be 16 katuns, 2 ahaus, 15 chuens, 0 days, equal to 116,220 days. Subtracting 6 calendar rounds, or 113,880 days, we get the remainder 2,340. As our last date was 1 Ahau, 8th day of Pax, 16th month of the year 6 Ben, we subtract from 2,340 days 57, the remaining days of the year 6 Ben. This leaves 2,283 days, which divided by 365 gives 6 years and an overplus of 93 days. Counting on table 3, 6 years from 6 Ben, we reach 12 Akbal, the next year being 13 Lamat. Counting on table 1, 93 days, or 4 months and 13 days, beginning with the column headed 13, and 13 days down the column headed 2, we reach 1, and find opposite, in the Lamat column, the day Ahau, which agrees with the plate. The dates obtained are, it must be remembered, based on the assumed starting point 1 Ahau, 13 Tzec, year 13 Lamat; this, however, does not affect the correctness of the result.

As has been stated, to obtain the true interval where calendar rounds (or cycles of 52 years) have been subtracted, these must be added. The true interval, therefore, between column B1 and A1 of our figure 8 is $6\times52+6=318$ years and $57+93$ days, or 318 years 7 months and 10 days.

These examples are sufficient to prove beyond any reasonable doubt the correctness of Dr Förstemann's method of counting the time symbols of the Dresden codex, and that his orders of units, or time periods, used in counting, up to and including the cycle, were precisely the same as those subsequently presented and used by Mr Goodman in his work. It also shows that my calendar tables 1 and 3 have the days, months, and years arranged consistently with the Dresden codex, and that they can be successfully used in examining and tracing the long or high time counts, at least so far as tried. We might dismiss the Dresden codex with these examples but for the fact that there are some series reaching still higher figures to which Dr Förstemann has called attention. Therefore, before passing to the inscriptions, a few of these will be noticed and the attempt to connect the dates which seem to be related will be made—something which has not been done by Dr Förstemann, and in which the proof of his theory lies.

We take as the first example the two series, black and red, running up the folds of the serpent figure, plate 69, following Dr Förstemann's method and assuming that the two series are connected. They are as follows, Goodman's names being attached:

	Red	Black	Difference		
					Days
Great cycles	4	4	0	equals	0
Cycles	6	5	0	equals	0
Katuns	1	19	1	equals	7,200
Ahaus	0	13	7	equal	2,520
Chuens	13	12	1	equals	20
Days	10	8	2	equal	2
Days below	9 Ix	4 Eb	Difference in days.		9,742

The total days of the two columns as given by Dr Förstemann are as follows:

Red	12,391,470
Black	12,381,728
Difference	9,742

Same as above.

As the month symbols are obliterated, we will assume 4 Eb under the black column to be the 5th day of the month Pop in the year 13 Lamat. Subtracting 360, the remaining days of the year 13 Lamat, from 9742, and dividing the remainder by 365, we obtain 25 years and 257 days, or 25 years 12 months and 17 days. Examining table 3, and counting forward from 13 Lamat 25 years, we reach 12 Ben. As the next year is 13 Ezanab, counting on table 1, 12 months and 17

days on this year, we reach 9 Ix, the 17th day of Mac, the 13th month of the year 13 Ezanab, which corresponds with the day under the red column.

As the columns and totals are precisely as given by Dr Förstemann (Zur Entzifferung der Mayahandschriften, 1891, p. 17), we have proof here of the correctness of his system and of the value assigned the several orders of units or time periods which, in one of the series, involves very high numbers, and also proof that they are precisely the same as the time periods used by Mr Goodman in his work, which appeared six years later, with the one exception noted below.

In calculating these series, Dr Förstemann has assumed that 20 units of the fifth order make one of the sixth order; or, to use Mr Goodman's nomenclature, that 20 cycles make one great cycle. Although the latter author counts but 13 cycles to the great cycle, according to the chronological system he believes was used by the authors of the inscriptions, he admits that in the Dresden codex the count was 20, which is evident from plate 31, where the place of the fifth order of units (cycles) has the number 19.

As the opportunity is afforded here of testing on a higher unit Mr Goodman's theory that the red oval indicates full count (20 where this is the proper number, or 18 where that is the number), I shall use it. As will be seen by reference to page 723 where the series are given, the ahaus of the red series are counted as 0 (naught), when according to Mr Goodman's theory they should be 20. Let us try the calculation with this number. Subtracting the black from the red as before, the result is as follows:

	Great Cycles	Cycles	Katuns	Ahaus	Chuens	Days
	4	6	1	20	13	10
	4	5	19	13	12	8
Difference.....			2	7	1	2

This difference reduced to days gives 16,942 instead of 9,742, as by the former method. Assuming 4 Eb under the black column, as before, to be the 5th day of the month Pop in the year 13 Lamat, we subtract 360, the remaining days of the year 13 Lamat, from 16,942, and, dividing the remainder by 365, obtain 45 years and an overplus of 157 days—7 months 17 days. By table 3 we find that counting 45 years from 13 Lamat brings us to 6 Ben, the next year being 7 Ezanab. By table 1 we ascertain that the 17th day of the 8th month of this year is 7 Ix. This is wrong, as it should be 9 Ix, the day number being the test in this case, as the addition of even months will necessarily bring us back to the same day. This shows Mr Goodman's theory on this point to be incorrect so far as the Dresden codex is concerned, where this particular symbol is chiefly, if not exclusively, used.

Our next example is from plate 62, is, like the preceding, in the

folds of a serpent (the one to the right), and consists of two series, one black, the other red. These have also been calculated by Dr Förstemann and arranged according to the order of units as given here. Mr Goodman's names are given opposite and differences to the right.

	Black	Red	Difference	
				Days
Great cycles	4	4	0 equals	0
Cycles	6	6	0 equals	0
Katuns	9	1	8 equal	57,600
Ahaus	15	9	5 equal	1,800
Chuens	12	15	15 equal	300
Days	19	0	19 equal	19
Days below	3 Kan	13 Akbal	Total	59,719
Months	16 Uo	1 Kankin		

Dr Förstemann's totals are as follows:

Black	12,454,459
Red	12,394,740
Difference	59,719

showing his result to be precisely the same as that obtained by using the Goodman periods, or rather showing the Goodman periods to be precisely the same as those used by Dr Förstemann with one exception. Before proceeding, it is necessary to notice that the day Kan is never the 16th day of the month, but may be the 17th, therefore the date 3 Kan 16 Uo, under the black column, must be changed to 3 Kan 17 Uo. In this example the counting must be backward in the order of time if we proceed from the lower to the higher series.

Subtracting 3 calendar rounds (56,940 days) from 59,719, the difference given above, the remainder is 2,779 days.

As 13 Akbal 1 Kankin, is the first day of the fourteenth month of the year 13 Akbal, we count backward from this date. In counting backward, if we start with—that is, include—the day named, the day sought will be the next beyond the last day counted. As 1 Kankin is the two hundred and sixty-first day of the year 13 Akbal, we subtract this number from 2,779, and, dividing the remainder by 365, obtain 6 years and a surplus of 328 days, taking from this the 5 added or intercalary days there remain 323, or 16 months and 3 days to be counted back on the year reached. Counting back on our table 3 6 years from the year 13 Akbal, we reach 7 Ben, the next year being 6 Lamat. Subtracting 16 months and 3 days from 18 months, the remainder is 1 month and 17 days; hence the day reached will be the seventeenth day of the month Uo in the year 6 Lamat. This, by reference to table 1,

is found to be 3 Kan, the same day as that below the column of black numerals, when the correction from 16 to 17 has been made.

As this paper is designed in part as a help to those commencing the study of the codices and inscriptions, we will, like the surveyor who sights back and forth to insure accuracy, trace this series forward, a process which should, as a matter of course, result correctly if our count was right in tracing it backward.

Starting with 3 Kan, the 17th day of the second month Uo, in the year 6 Lamat, we count forward to the end of this year 328 days, which, subtracted from 2,779, the remainder given above, leave 2,451 days to be counted. Dividing by 365, we obtain 6 years and an overplus of 261 days, or 13 months and 1 day. Counting forward on table 3 6 years from the year 6 Lamat, we reach 12 Ezanab, the next year being 13 Akbal. Counting on table 1 the term of 13 months and 1 day, beginning with the column headed 13, we reach the same 13, and opposite in the Akbal column find the day Akbal. The date is therefore 13 Akbal, the 1st day of the fourteenth month—Kankin—of the year 13 Akbal, which proves the process to be correct.

Our next example consists of the two series, same plate of the Dresden codex, placed in the folds of the left serpent, as follows (prefixing Goodman's names as before):

	Red	Black	Difference		
					Days
Great cycles	4	4	0	equals	0
Cycles	6	6	0	equals	0
Katuns	11	7	3	equal	21,600
Ahaus	10	12	18	equal	6,480
Chuens	7	4	2	equal	40
Days	2	10	12	equal	12
Days below	3 Ix	3 Cimi		Total	28,132
Months	7 Pax	14 Kayab			

Subtracting from 28,132 one calendar round—18,980 days—leaves 9,152 days. As it is somewhat easier to count forward than backward, though the other order appears really to be the one adopted here, we will begin with the date under the red column—3 Ix the 7th day of the sixteenth month (Pax) of the year 9 Lamat. As there remain 58 days in this year after the date given, we subtract this number from 9,152 and divide the remainder by 365, and obtain 24 years and an overplus of 334 days, or 16 months and 14 days. Referring to table 3, we find that by counting forward 24 years from 9 Lamat, we reach 7 Lamat, the next year being 8 Ben. By table 1 we find

that the 14th day of the seventeenth month (Kayab) of this year is 3 Cimi, which proves the calculation to be correct.

To those familiar with the Dresden codex it will be apparent that the month symbol used under the red column looks as much if not more like that for Tzec than that for Pax, yet, as it has elements of both and as the calculation works out only with Pax, it has been assumed that this is the month intended. That the month Tzec can not in any way be made consistent with the numbers of the series is easily made manifest thus: 3 Ix, the 7th day of the fifth month Tzec, will fall only in the year 8 Lamat, and 3 Cimi, the 14th day of the seventeenth month Kayab, only in the year 8 Ben. Looking on table 3, we see that in counting forward from 8 Lamat to 8 Ben we pass over an interval of only 12 years, and in counting backward over an interval of 38 years. As the interval shown by the numerals is (after one calendar round, which does not affect the count, has been subtracted) 9,152 days, it is apparent that 7 Tzec can not be the date intended. Förstemann's totals of these series are as follow:

Red	12,466,942
Black	12,438,810
Difference	28,132

showing precisely the difference given above. The absolute difference between the two dates is 2 months 18 days+52 years+24 years+16 months+14 days, which, together, equal 77 years and 27 days.

The immense stretch of these periods is a point not to be overlooked. One of those referred to amounts to 12,466,942 days, or 34,156 years and 2 days, counting 20 cycles to the great cycle, according to Förstemann's method. This brings up again the question as to the number of units of the fifth order to form one of the sixth, or, using Goodman's terms, the number of cycles which make a great cycle. Although the discussion of this question would perhaps be more appropriate after we have considered the inscriptions, it may as well be introduced here.

Mr Goodman, while holding 13 as the number in the inscriptions, admits that in the Dresden codex 20 was the number used; but this admission only renders the subject more complicated, as there is no reason to believe that a different rule prevailed in the inscriptions from that in the codex. That the vigesimal system of notation was the rule among the Maya tribes is well known, the use of 18 units of the second order to make one of the third, in time counting, having apparently been adopted for convenience in bringing the month into the calculation. This fact, though not positive proof of regular vigesimal succession elsewhere in the time system, is sufficient to justify the assumption of regularity, unless satisfactory evidence of variation can be adduced.

Although the last example reaches to the great cycle, and involves

the count of cycles, it does not afford the proof necessary to decide this question, as is apparent by trial, as the difference between the two series will be the same whether we count 20 cycles to the great cycle or 13. There is, however, one series in the codex (plate 31) heretofore referred to which will decide this point. This, which is in the right half of the upper division, is as follows:

19 cycles
9 katuns
9 ahaus
3 chuens
0 days

There is also one series in the inscriptions found on Maudslay's Stela N of the Copan ruins which seems to settle the question. This is as follows:

14 great cycles
17 cycles
19 katuns
10 ahaus
0 chuens
0 days

This reckoning, however, Mr Goodman assures us "is not only wrong, but absurd as well. The cycles run only to 13, and no such reckoning backward or forward from the initial date would reach a 1 Ahau 8 Chen," the next date, the first being 1 Ahau 8 Zip. He changes it to 14 great cycles, 8 cycles, 15 katuns, 10 ahaus, 18 chuens, 20 days.

It is true that, with the interpretation given of the date characters and the chuens and days, the reckoning backward or forward would not reach 1 Ahau 8 Chen. But this interpretation is by no means certain throughout. In the first place, it is not certain, judging by Maudslay's photograph, that the chuen symbol does not have a numeral 1 at the left, as it is like one on Stela C, where, according to Maudslay's drawing, there is 1, and the count may possibly, as will hereafter appear, reach back to some more distant date, as is found to be the case in several inscriptions. However, Mr Goodman interprets it differently.

In the second place, the month symbol of this last date can not with absolute certainty be interpreted Chen; for as shown by the photograph it may be Yax, Zac, or Ceh, apparently Zac. The numerals attached to the higher periods are clear and distinct, but the month symbol of the first date, which is upside down, is as much like Uo as like Zip, if we judge by Mr Goodman's month figures. If we suppose the sign to the left of the chuen symbol to be 1 and the number of ahaus to be 9 instead of 10, the reckoning from 1 Ahau 8 Zip will bring us to 1 Ahau 8 Mol, the eighth month, instead of the ninth. This change, however, would not be justified, nor is the change made

by Mr Goodman until he has clearly proved not only that 13 cycles form a great cycle, but also that his arrangement of the chronologic system, which will be referred to further on, is correct.

While the series of the codex which have been given as examples work out correctly, it must be admitted that there are others which can not be successfully traced without arbitrary corrections. Nevertheless, those given, and others rising to the fifth order of units that might be noted, which give correct results, are sufficient to prove the rule. Before we leave the codex, reference will be made to some series with double numbers—that is, one series interpolated with another, one of which Dr Förstemann is inclined to believe is a correction of the other. In these cases the interpolated series, or supposed correction, is in red, the other in black.

As an example, we take the following series from plate 51, using Goodman's names:

	Black	Red	Black	Red
Cycles	1	3	1	2
Katuns	8	4	6	11
Ahaus	4	15	11	10
Chuens	14	12	10	11
Days	0	0	0	0
Day below	12 Lamat		12 Lamat	

Subtracting the black of the right pair from the black of the left, we get the remainders 1, 13, 4, 0; that is, 1 katun, 13 ahaus, 4 chuens, 0 days, making 11,960 days. As no month number is given, we assume 12 Lamat to be the first day (1 Pop) of the year 12 Lamat. Subtracting 364, the remaining days of this year, from 11,960, and dividing the remainder by 365, we obtain 31 years and an overplus of 281 days or 14 months and 1 day. By table 3 we ascertain that 31 years from 12 Lamat bring us to 4 Akbal, the next year being 5 Lamat. By table 1 we ascertain that the first day of the fifteenth month is 12 Lamat, the proper date.

The difference between the red series of the two pairs is 13 katuns, 5 ahaus, 1 chuen, 0 days, equal to 95,420 days. Subtracting from this 5 calendar rounds (94,900 days) 520 days remain. Assuming 12 Lamat to be the first day of the year 12 Lamat, and subtracting 364, the remaining days of this year, from 520, we get 156 days or 7 months and 16 days, to be counted on the next year, which is 13 Ben. This reckoning reaches 12 Lamat, the sixteenth day of the month Mol. The result in both cases is correct, so far as the dates reached are concerned, but the interval between the black series is only 364 days+31

years+281 days, while that between the red series is more than 261 years. It is possible, therefore, that the red, which run through the several columns of this and the following plate, represent an independent series.

There are, however, some interpolations which clearly appear to be corrections; for example, these two series on plate 59:

Black	Red
8 13 0	6 9 0
6 9 0	2 3 0
2 4 0	4 6 0

The day below each is 13 Muluc. Using the difference between the black series—2 ahaus, 4 chuens, 0 days, equal to 810 days—and taking 13 Muluc, the 2d day of the month Pop in the year 12 Lamat as our starting point (always counting forward when it is not otherwise stated), we reach the day 4 Cauac, 2 Tzec, year 1 Ezanab, not the correct date, as it should be 13 Muluc. Using the difference between the red series—4 ahaus, 6 chuens, 0 days = 1,560 days—assuming the same starting point as before (13 Muluc 2 Pop, year 12 Lamat), and counting forward 1,560 days, we reach 13 Muluc, 2 Tzec, year 3 Lamat. This is a correct result, and indicates that the red numerals were inserted as a correction.

FIG. 16—Part of plate 69, Dresden codex.

On plate 69 we find a series (figure 16) represented by symbols of the same form as those in the inscriptions. The glyphs A1, B1 represent the first date—4 Ahau 8 Cumhu (eighteenth month)—which must fall in the year 8 Ben. At A7, B7 is the next date—9 Kan 12 Kayab. The intermediate counters, comparing with those discovered by Goodman in the inscriptions, are as follows: A5, 15 katuns; B5, 9 ahaus; A6, 4 chuens; B6, 4 days. There are other characters with numerals between the two dates, some of which may be hereafter explained, but none of these, as will be shown hereafter, are customarily counted as part of the time interval.

As I may have occasion to refer again to this series and the exactly similar one on plate 61, I shall only show at present the way in which it is to be used, and call attention to the exact similarity of

the time symbols to those of the inscriptions already figured and those presented farther on.

By referring to *a* and *b* of figure 10, showing the katun symbols, the strong resemblance to glyph A5 of the series now under consideration is at once seen. The resemblance of B5 to *a* and *b*, figure 9, showing the ahau signs, is also apparent, as is A6 to the chuen symbol, figure 8. B6 is the kin or day symbol. Here it seems the numbers denoting days are not attached to the chuen symbol, as is usual in the inscriptions, the day, in the abstract sense, having its appropriate symbol, to which the numerals denoting the number of days are attached.

As the usual order in which the glyphs are to be read is from the top downward, by twos and twos where there are two columns, we will take the first pair, A1 and B1, as the date from which to count. This, as already stated, is 4 Ahau, the 8th day of the 18th month—Cumhu—of the year 8 Ben, which, as will be seen by referring to our table 3, is the forty-seventh year of the cycle of years, or calendar round. Changing these time periods to days—

	Days
15 katuns	108,000
9 ahaus	3,240
4 chuens	80
Days	4
The aggregate is	111,324
Subtract 5 calendar rounds	94,900
There remain	16,424

Subtracting from this remainder 17, the number of remaining days in the year 8 Ben, from 4 Ahau 8 Cumhu, and dividing the remainder by 365, we obtain 44 years and 347 days, equal to 17 months and 7 days. Counting forward on table 3, 44 years, we reach 13 Ben, the next year being 1 Ezanab. Turning to table 1 we find that 17 months and 7 days bring us to 9 Kan, 7 Cumhu, instead of 9 Kan 12 Kayab, which is given on the plate. Counting backward from 4 Ahau 8 Cumhu, as the symbols apparently indicate should be done (if the order be as in the inscriptions), results in a still wider variation from the correct date, assuming that the symbols on the plate—which are very distinct and unmistakable—are correct.

If the dates on the plate are correct, the first falls in the year 8 Ben, and the latter in 3 Ben. Counting forward there would be an interval (omitting the calendar rounds) of only 7 years and the fractions of the 2 years in which the two dates fall, manifestly too small for the numeral symbols. Counting backward there would be an interval (omitting the calendar rounds) of 43 years and the fractions of the 2 date-years, making, in all, 16,076 days, or 348 days short of that required by the time symbols after deducting the calendar rounds. As there

are other symbols between the dates with numerals attached, it is possible the explanation needed is found in them. In the parallel passage on plate 61, which appears to have the same beginning and ending date, there is but one dot to the chuen symbol (indicating 1 chuen) and the symbol for 3 days. This gives a total (omitting the calendar rounds) of 16,363 days. But this gives no satisfactory result.

I have dwelt somewhat at length on these series as they are the only ones with two legible dates in the codex which show the higher time periods in symbols. They will serve, however, to show the close relation which this codex bears to the inscriptions, to which we will now turn, beginning with those at Palenque.

Inscriptions at Palenque

Before proceeding with these, in order to show exactly Mr Goodman's method of calculating a series from the inscriptions, I present as an example one which he has fully worked out. This series is found in the inscription of the Temple of the Sun, at Palenque. It will be more critically examined hereafter by comparison with Maudslay's photograph. At present I use Goodman's determination merely for the purpose of illustrating the method of reckoning.

The dates and intervening time periods as he gives them are as follows: 4 Ahau, 8 — (month not identifiable), 16 days, 5 chuens, 18 ahaus, 12 katuns, and 9 cycles, followed by the date 2 Cib, 14 Mol. Reducing these time periods to days, the result is as follows:

	Days
9 cycles	1,296,000
12 katuns	86,400
18 ahaus	6,480
5 chuens	100
16 days	16
Total	1,388,996
Deduct 73 calendar rounds	1,385,540
This leaves	3,456

As the first date can not be fully determined, it will be necessary to count back from the second date—2 Cib 14 Mol, which falls in the year 5 Akbal. Subtracting 154, the preceding days of this year, from 3,456 and dividing the remainder by 365, we obtain 9 years and 17 days. Deducting 5 for the added days, there remain 12 to be counted back on the last month of the year 8 Ben, which we find by counting back on table 3 is the year in which the first date falls. This gives 4 Ahau 8 Cumhu, which is, no doubt, correct, as this date is a very common one on the Palenque inscriptions.


A
B
C
D
E
F
G
H
I
K
L
1
2
3
4
5
6
7
8

A PORTION OF THE TABLET OF THE CROSS, PALENQUE.

PHOTOGRAPHED FROM A PLASTER CAST.

Mr Goodman, after ascertaining the number of days in the time periods precisely as they are given above, proceeds as follows:

From these [1,388,996 days] we deduct as many calendar rounds as possible, being 73, or 1,383,540 days, leaving 3,456. From these we take 155, the number of days from the beginning of the year to 14 Mol, that being the only date we are certain of. This leaves 3,301 days. From these deduct all the years possible, being 9, or 3,285 days. There are now but 16 days left. Reckoning back from the end of the year, we find these reach to 8 Cumhu [according to his method of numbering the days of the month], a circumstance that enables us easily to recognize the strange sign as a variant of the symbol for that month. Turning now to the Annual Calendar, we find that 4 Ahau–8 Cumhu occurs on page 7, and, passing over 9 years till we come to page 17, we find that 2 Cib falls on the 14th of Mol in that year. Thus we are satisfied that the strange month sign is a symbol for Cumhu, and that the cycles, katuns, ahaus, chuens, and days represent the period between the two dates, the full reading being: 9–12–18–5×16, from 4 Ahau–8 Cumhu, the beginning of the great cycle, to 2 Cib–14 Mol.

As our process is intended to be independent of Mr Goodman's tables, it is necessary for us to divide by 365 in order to find the intervening years, and to determine the full date including the year, which Mr Goodman fails to do.

TABLET OF THE CROSS

Proceeding now with the Palenque inscriptions. Attention is directed first to that on the so-called Tablet of the Cross, the right slab of which is fortunately safely housed in the United States National Museum. The inscription on this slab is well known through the excellent autotype in Dr Rau's paper entitled Palenque Tablet, but, in order to place the record before the reader in as complete a form as is possible, I have given a copy in figure 17*a*, and a copy of Maudslay's photograph of the left slab in figure plate XL; a drawing of the few characters above the arms of the right priest in the middle space is shown in figure 17*b*.

As this is the most important of all the known Mayan inscriptions, for the purpose of testing Mr Goodman's discoveries, I shall examine it somewhat fully, and to this end give below a list of the dates and series in the order they stand, beginning with the large initial on the left slab. It is necessary, however, first to notice somewhat particularly the initial series of the left slab.

The first character of this series is the large glyph covering spaces A1, B1, and A2, B2. This Mr Goodman interprets as the great cycle, which is equivalent to the sixth order of units. I am inclined to believe this interpretation is correct. The reasons for this belief are the form of the body or chief element of the glyph, which is similar to that of the ahau and katun; and the fact that it always follows in the ascending scale (counting backward or upward) the cycle, there being, so far as known, no exception to this rule in the

initial series. This is shown not only in initial series like the one here represented, where numeral prefixes are face characters, but in a number of others where the ordinary units, balls and lines,

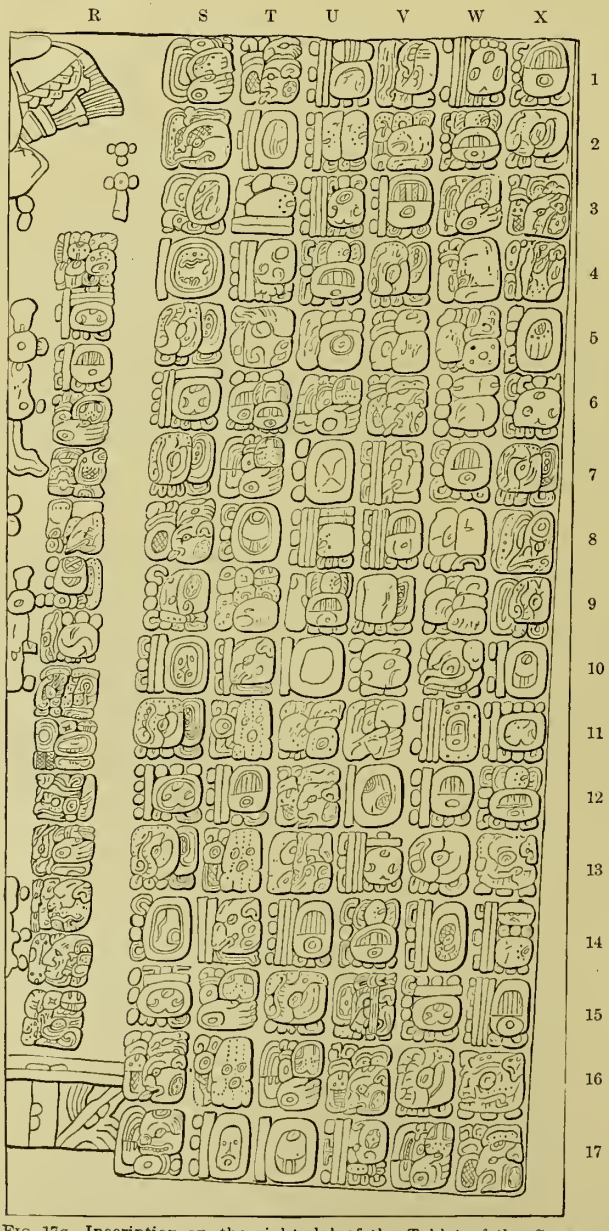


FIG. 17*a*—Inscription on the right slab of the Tablet of the Cross, Palenque.

are prefixed to the glyphs representing the lower orders (cycles, katuns, etc.). Another reason for this belief is that positive evidence is found in the Dresden codex and in the inscriptions that there is an

order of units above the fifth, or cycle; that is to say, a sixth, or great cycle, as Mr Goodman calls it. This being true, there is every rea-

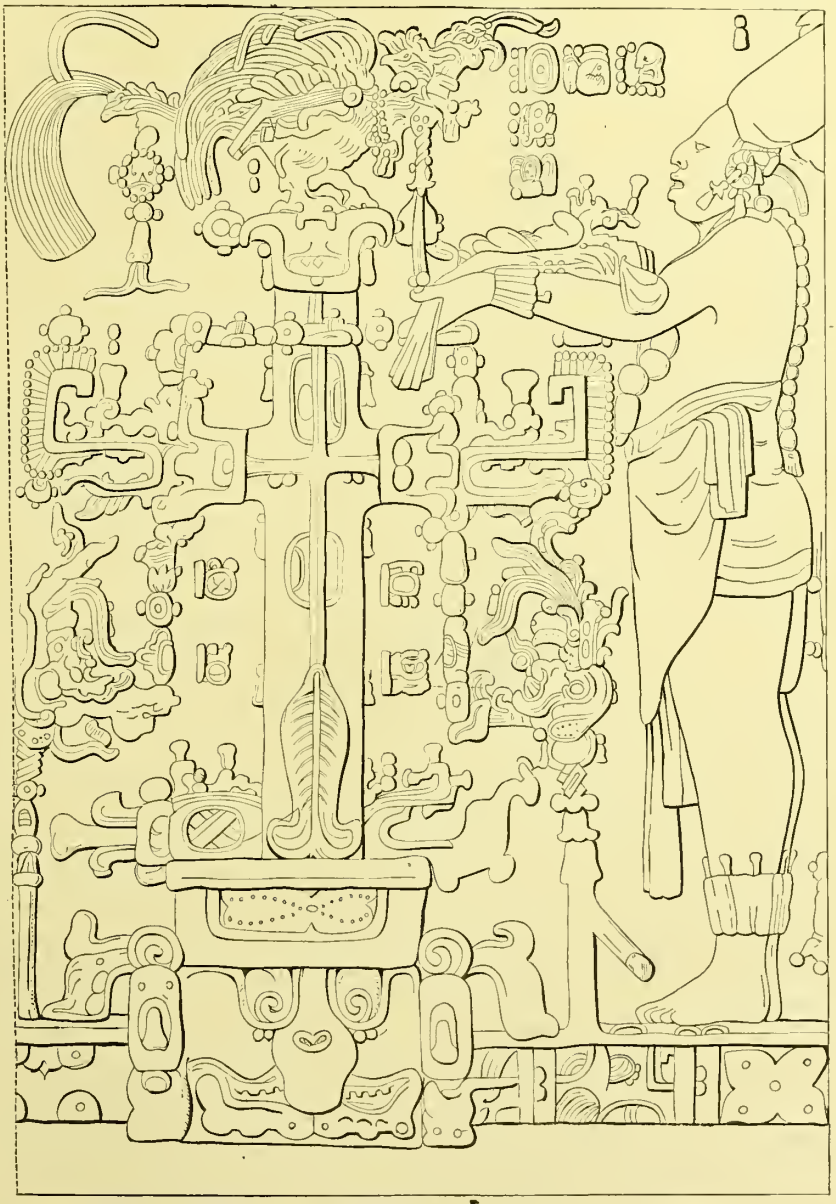


FIG. 17*b*—Inscription on the middle space of the Tablet of the Cross, Palenque.

son to believe that it would be represented in the inscriptions by a special character.

Examining the seven succeeding double glyphs in the order in which they stand, they are found to be as follows: A3, B3, a face character and

the cycle symbol (see figure 11*a*); A4, B4, a face character and the katun symbol (see figure 10*a*); A5, B5, a face character and the ahau symbol (see figure 9*b*); A6, B6, a face character and the chuen symbol (see figure 8*a*); A7, B7, an unknown character (dise with hand across it) and the symbol for day (kin) in the abstract sense, same as the lower portion of the symbol for the month Yaxkin. At A8, B8, a face character and the symbol for the day Ahau; A9, B9, a face character and the symbol for the month Tzec. These are interpreted by Mr Goodman as follows: "53–12–19–13–4×20—8 Ahau 18 Tzec"; that is to say, the fifty-third great cycle, 12 cycles, 19 katuns, 13 ahaus, 4 chuens, 20 days, to 8 Ahau 18 Tzec. From this it is seen that he interprets the prefixed face characters as numerals, assigning to each a particular number determined by the minor details or otherwise.

Omitting, for the present, consideration of the number given to the great cycle, let us see if there is any reason for believing that he is correct in assigning numeral values to the face characters attached to the time-period symbols, or, as we term them, symbols of the orders of units. Taking the known time-period symbols in this series, observing the regular descending order in which they stand, and being aware of the fact that in several other similar initial series the face characters are replaced by the ordinary numeral symbols (balls or dots and short lines), the evidence seems to justify Mr Goodman's belief. Another strong point in favor of this belief is that at A8, B8, and A9, B9, which contain the symbols for the day Ahau and the month Tzec, we most certainly find a date which could not be complete without attached numerals. As the places of the numerals are filled by face characters, the most reasonable conclusion is that they represent these numerals. The evidence therefore in favor of Mr Goodman's theory seems to justify its acceptance. But here the question arises, what evidence have we that the numbers assigned to these face glyphs are correct? Admitting that they are numeral symbols, it is certain that they do not indicate numbers higher than 20, almost certainly not exceeding 19, as there are other symbols for full count or 20. It is also certain that the one attached to the symbol for the day Ahau does not exceed 13, and that the one attached to the chuen symbol does not exceed 18. We are thus enabled to limit very materially the field of inquiry, but to be entirely satisfactory there must be actual demonstration. If 8 Ahau 18 Tzec could be connected by intervening numbers with a following date this would be demonstration that the numbers given to the date symbols are correct. As will be seen farther on, Mr Goodman connects it by means of series 4 (left slab), given below, with 9 Ik (glyph E9); but the month date reached is 20 Chen instead of 20 Zac, as given in the inscription. While we may accept this as possibly or even probably a correct result, yet it is not demonstration; moreover, (what appears to be an equally probable and more acceptable explana-

tion, as will be shown farther on) by simply adding two days to the first numeral series connection will be made with the date of the third series. There is, however, as will be seen, at least one initial series with face characters in place of numerals where connection is properly made according to Mr Goodman's number with a following date.

As there will be occasion to refer frequently to the series on the different divisions of the tablet we give here a list of these series in the order in which they occur, beginning with the closing date of the initial series on the left slab, the years being added in parentheses. The numeral series are given in cycles, katuns, ahaus, chuens, and days, followed by their equivalent in days placed to the right; and where the sum is greater than a calendar round, the remainder, after subtracting the calendar rounds, is also shown. The term "left slab" (though not strictly correct) is used only to include the six columns at the left; "right slab," the six columns at the right; and "middle space," to include the entire space between the six columns at the left and the six columns at the right. The series as here given are based on inspection:

Left slab

Number of series		Days
	8 Ahau 18 Tzec (2 Akbal)	
	1 Ahau 18 Zotz (2 Akbal)	
1	8 5 0	2,980
	4 Ahau 8 Cumhu (8 Ben)	
2	1 9 2	542
	13 Ik 20 Mol (10 Akbal)	
3	1 18 3 12 0 (274,920 days)	9,200
	9 Ik 15 Ceh (9 Lamat)	
4	2 1 7 11 2 (297,942 days)	13,242
	9 Ik 20 Zac (11 Akbal)	
5	3 6 10 12 2 (479,042 days)	4,542
	9 Ik (no month)	
6	1 6 7 13	9,513
	(The next date comes in the middle space)	

Middle space

	9 Akbal 6 Xul (13 Akbal)	
1	1 8 17	537
	13 Ahau 18 Kankin? or Kayab?	
	3? 4? or 8? ? 3 ? (not determinable)	
2	6 11? 6	2,386?

Right slab

	11.....? 20 Pop 5 Cimi? 14 Kayab?	
1	1 2 5? 14..... 1 Kan 2 Kayab? (5 Akbal?) 11 Lamat 6 Xul (10 Akbal)	8,034
2	13 3 9..... 2 Caban 10 Xul (10 Lamat)	4,749
3	6 3..... 8 Ahau 13 Ceh (10 Lamat)	123
4	1 8 1 18..... 3 Ezanab 11 Xul (10 Lamat)	10,118
5	1 16 8? 18?..... 5.....? (Ahau?) 3.....? (Tzec?) 5.....? 20 Zotz	13,138
6	1 19 6 16..... 5 Kan 12 Kayab (12 Ben)	14,176
7	2 2 4 17..... 1 Imix 4.....? (Zip or Ceh)	15,217
8	1 1 1..... 7 Kan 17 Mol (7 Lamat)	381
9	2 8 4 7..... 11 Cib? 14 Kayab? (3 Akbal?)	17,367
10	16 or 17? 8 2..... (No date follows to the close)	7,002?

The first day of the left slab—8 Ahau 18 Tzec—has the numbers given in face characters, as has been stated; those given are according to Mr Goodman's interpretation.

The date following number 4, left slab, is corrected by Mr Goodman from 9 Ik 20 Zac to 9 Ik 20 Chen.

Mr Goodman corrects the number of days in the sixth series, left slab, from 9,513 to 9,512.

The month of the date (13 Ahau 18 Xul? or Kayab?) in the middle space, Mr Maudslay, in his drawing (part 5), probably inspired by Mr Goodman, is inclined to give as Kankin, in which he is probably correct. The nearly obliterate glyph which follows he gives as 8—? 3 Kayab. This interpretation is, however, exceedingly doubtful.

Maudslay, in his drawing of the middle space (part 10), gives 13 as the number of chuens in the second series. He is also evidently inclined to give the first date on the right slab (11—? 20 Pop) as 11 Caban 20 Pop; and the second, 5 Cimi 14 Kayab, as is indicated in the preceding list. Though there is some doubt as to the number of

chuens, first series, right slab, this author follows Rau's restoration and gives it as 5, yet it may possibly be 4 or but 3, as the glyph is exactly in the line of a break repaired by Dr Rau.

The number of chuens as well as days in the fifth series of the right slab is uncertain. Maudslay indicates 8 for the former and 18 for the latter, which is apparently correct. The two dates following this series, except the month (20 Zotz) of the second, are almost entirely obliterated. I believe the day of the first to be Ahau. Maudslay does not attempt a restoration, but agrees with my suggestion as to the month. He suggests Caban as the day of the second date. He gives Zip as the month in the date following the seventh series of this slab. The date following the ninth series he gives as 11 Chicchan 13 Yax or Chen, his figure being uncertain. The number of ahaus in the tenth series is left uncertain by him; he apparently prefers 16, though his figure may be construed as 18. The three lines (15) are distinct in the inscription, but the number of balls forming the fourth line is uncertain; the number seems to me to be 16 or 17.

In referring to the inscription, Rau's scheme, given on page 61 of his Palenque Tablet—to wit, letters above for each column and numbers at the sides for the lines—will be followed here (not Maudslay's), it being remembered that the columns, where there are more than one, are to be read two and two from the top downward, single columns from the top downward, and single lines from left to right.

Referring now to the left slab, we will first point out the location in the inscription of the glyphs denoting the several dates and numeral series, the latter being reversed to agree with the order in which they come in the inscription, the first date—8 Ahau 18 Tzec—being that with which the initial series terminated.

Series	
	8 Ahau (A8 B8) 18 Tzec (A9 B9)
	1 Ahau (A16) 18 Zotz (B16)
First	0 days 5 chuens (D1) 8 ahaus (C2)
	4 Ahau (D3) 8 Cumhu (C4)
Second	2 days 9 chuens (D5) 1 ahau (C6)
	13 Ik (C9) 20 Mol (D9)
Third	0 days 12 chuens (D13) 3 ahaus (C14) 18 katuns (D14) 1 cycle (C15)
	9 Ik (E1) 15 Ceh (F1)
Fourth	2 days 11 chuens (E5) 7 ahaus (F5) 1 katun (E6) 2 cycles (F6)
	9 Ik (E9) 20 Zac (F9)
Fifth	2 days 12 chuens (E10) 10 ahaus (F10) 6 katuns (E11) 3 cycles (F11)
	9 Ik (F12) no month given
Sixth	13 days 7 chuens (F15) 6 ahaus (E16) 1 katun (F16)

We begin, therefore, in our attempt to trace the series and connect the dates with 8 Ahau 18 Tzec (as Mr Goodman interprets the numeral face characters), which falls in the year 2 Akbal. As it is followed by another date (1 Ahau 18 Zotz) without any recognized

intervening numeral intended to be used as a connecting series, we must assume that if it is connected with any of the following dates it must be by means of one of the series coming after the second date. Mr Goodman does not begin his attempts at tracing the connections in the inscription on this slab with the first date, but, after noticing the initial series, and taking 1 Ahau 18 Zotz as his starting point, says (page 135):

> After three glyphs, which are probably directives stating that the computation is from that date, there is a reckoning of 8–5×20 [that is, 8 ahaus 5 chuens 20 days], with the directive signs repeated, to 4 Ahau 8 Cumhu [the third date given above]. * * * This reckoning is a mistake. It should be either 6–14×20, the distance from 8 Ahau 18 Tzec to 4 Ahau 8 Cumhu, or 6–15×20, the distance from 1 Ahau 18 Zotz—more likely the latter, as it will presently be seen that other reckonings go back to that date.

Before referring to Mr Goodman's suggestions, we find by trial that this first date (8 Ahau 18 Tzec, year 2 Akbal) will not connect with any of the dates on the left slab, nor middle space, by either of the numeral series as given. If, however, we add two days to the first numeral series, making it 2,982 days, and count forward from 8 Ahau 18 Tzec, we reach 13 Ik 20 Mol in the year 10 Akbal, the date following the second series. This, it is true, skips over the immediately following date (4 Ahau 8 Cumhu, year 8 Ben), but if we subtract the second numeral series (542) from the first (2,982, as corrected) the remainder, 2,440, counting forward from the same date, will bring us exactly to 4 Ahau 8 Cumhu 8 Ben. Are these two coincident correct results to be considered accidental? They might be but for the additional fact that if 542 be subtracted from the sum of the first three series (first, second, third) with added two days to the first, the remainder, counting forward from 8 Ahau 18 Tzec 2 Akbal, will reach 9 Ik 15 Ceh 9 Lamat, the date following the third numeral series.

Turning now to Mr Goodman's explanation of the first series and the accompanying dates, I notice first the fact that here as elsewhere he interprets what I consider the symbol for naught (0) as equivalent to 20; thus the number of days of the first series instead of 2,980 would be, following his explanation, 3,000—that is to say, the numeral series, as he gives it, is 8 ahaus 5 chuens 20 days, my interpretation being 8 ahaus 5 chuens 0 days. The chuen symbol here is of the usual form, that shown in figure 1 *a*; the ahau is a face form similar to that shown at figure 2 *b*. That there is a mistake here, as Mr Goodman asserts, is evident, if the two dates given, 1 Ahau 18 Zotz and 4 Ahau 8 Cumhu, are to be connected by the intermediate time periods. As 1 Ahau 18 Zotz falls in the year 2 Akbal, and 4 Ahau 8 Cumhu in the year 8 Ben, the interval is six years and the fractional days of the two years

(2 Akbal and 8 Ben), the total, in days, being 2,825, whereas the intermediate time periods, as interpreted by Mr Goodman, give 3,000, or, omitting the 20 days, according to Maudslay's interpretation of the symbol, which appears to be correct, 2,980 days. It is apparent therefore that there is some mistake here—that is, supposing the theory that the two dates are intended to be connected by the intermediate time symbols be true.

Mr Goodman suggests two ways of making the correction—first, by assuming 8 Ahau 18 Tzec to be the date from which to count, and changing the intermediate numeral series from 8 ahaus 5 chuens to 6 ahaus 14 chuens, thus making two radical alterations; in other words, a new numeral series to fit the case. This he obtains by subtracting the initial series as he has given it, from the 13 cycles composing his fifty-third great cycle, thus—

13— 0— 0— 0—0
12—19—13— 4—0
———————————
6—14—0

His other method is to change the intermediate time periods or numeral series to 6 ahaus 15 chuens—which is also making a new series—and to count from 1 Ahau 18 Zotz.

In making these proposed changes Mr Goodman seems to drop out of view his 20 days, as in fact he does throughout in his calculations. He gives the full count—20 for days, ahaus, and katuns, and 18 for chuens—in noting the numeral series, but appears to treat them as naughts in his calculations. This is evident from the numbers he gives in the present instance. As conclusive evidence on this point it is only necessary to refer to the preface to his "perpetual chronological calendar" (op. cit., not paged), where he says of the series 9—15—20—18×20, "there are no days, chuens, or ahaus in this date." Mr Maudslay, in his illustration of Goodman's method of interpretation before the Royal Society of England, June 17, 1897, in which he uses a newly discovered inscription (see figure 20), counts the character at the side of a chuen symbol (C1), precisely like that attached to our chuen, as equivalent to naught. In the case he refers to there are two lines above the symbol, counted as 10 chuens. Speaking of it he says:

> C1 is the chuen sign with the numeral 10 (two bars=10) above it and a "full count" sign at the side. Whether the 10 applies to the chuens or days can only be determined by experiment, and such experiment in this case shows that the reckoning intended to be expressed is 10 chuens and a "full count" of days—that is, for practical purposes 10 chuens only, for as in the last reckoning, when the full count of chuens was expressed in the ahaus, so here the full count of days is expressed in the chuens.

In other words, that the character at the side simply means that no

days are to be counted, and so his figures giving the number of days show. But this, as has been shown, will not suffice to correct the mistake in our example. However, a very slight change, as I have shown, which Mr Goodman failed to find, which is simply adding 2 days to the time periods, will suffice to bring the series into harmony with the theory, and at the same time to verify his determination of the face numerals attached to the terminal date of the initial series—8 Ahau 18 Tzec (year 2 Akbal).

Although the initial series will be discussed farther on, it will perhaps be best to indicate here the probable processes by which Mr Goodman reached his conclusions in regard to the series now under consideration.

According to the system which he has adopted and which he claims was the chronologic system of the inscriptions, 13 cycles, or units of the fifth order, make 1 great cycle, or 1 unit of the sixth order, and 73 great cycles complete what he terms the "grand era." As this system will be more fully explained farther on, it is only necessary to state here that he concludes from his investigation that the dates found in the inscriptions all fall in the fifty-third, fifty-fourth, and fifty-fifth great cycles. As these are taken by him to be absolute time periods, each begins with its fixed and determinate day; in other words, there is no sliding of the scale. According to this scheme the fifty-third great cycle began with the day 4 Ahau 8 Zotz, the fifty-fourth with 4 Ahau 8 Cumhu, and the fifty-fifth with the day 4 Ahau 3 Kankin, these dates following one another at the distance of one great cycle apart, which is correct on his assumption that 13 cycles make one great cycle, a conclusion which I shall have occasion to question.

Now, it is apparent that he assumes that 4 Ahau 8 Cumhu, the day following the first numeral series noted above, is the beginning day of his fifty-fourth great cycle. This being assumed, it follows that the preceding dates, 8 Ahau 18 Tzec and 1 Ahau 18 Zotz (which precedes the former in actual time by precisely one month), must fall in his fifty-third great cycle; and as the former (8 Ahau 18 Tzec) is the terminal date of the initial series, therefore this initial series goes back to 4 Ahau 8 Zotz, the beginning day of the fifty-third great cycle. As the time to be counted back from 4 Ahau 8 Cumhu to reach the closing date of the initial series is, according to the first numeral series, 8 ahaus, 5 chuens, 0 days, or 2,980 days, it must necessarily fall in the last katun of the fifty-third great cycle, which, according to his peculiar method of numbering periods, will be the 19th katun of the twelfth cycle. Counting back into this katun (using his tables), 8 ahaus and the 5 months carries us into the ahau beginning with 1 Ahau 8 Uo, as the only day Ahau of this period falling in the month

Tzec—which the inscription requires—is 9 Ahau 8 Tzec, which requires a numeral series of 3,180 days, or 8 ahaus 15 months. As Mr Goodman concludes that the face numeral prefixed to the symbol for the month Tzec should be interpreted 18, the nearest position in which a day Ahau the 18th of the month Tzec can be found, is in the thirteenth ahau of this katun. From this date to 4 Ahau 8 Cumhu is 6 ahaus 14 chuens; hence his proposed change in the numeral series.

The question therefore to be answered before we can give full assent to his conclusion is this, Are his renderings of the face characters reliable? That they represent numbers seems to be evident, as I show elsewhere, but the data presented in his work are not entirely satisfactory. That the initial series now under consideration contains one or more cycles, one or more katuns, one or more ahaus, and one or more chuens—or, as I term them, units of the fifth, fourth, third, and second orders—is certain; and that the terminal date is a day Ahau in the month Tzec is also true if the inscription be correct. The language used by Mr Goodman in defining the face numerals indicates that he has relied to some extent on his system of interpretation rather than on the details of the glyphs in determining their value, but this can be decided only by a careful examination of all the inscriptions in this respect, which it is my purpose to make in a supplemental paper when Maudslay's figures of the Quirigua inscriptions are received. When the count can be based on the glyphs his scheme will not interfere with a correct count. For example, 4 Ahau 8 Cumhu of this series may or may not be the first day of his fifty-fourth grand cycle, for in either case the count will bring the same result; nor will the fact that there are probably 20 cycles to the great cycle change the result. However, the subject will be further discussed when we consider the initial series, and for the present we will accept Mr Goodman's determination of the face numerals with the above implied reservation.

I have dwelt somewhat at length on this example in order to show some of the methods of determining positively that there is an error in the original, and the seeming impossibility in some cases of correcting it. Occasionally this can be done by means of a connected preceding or following series; or, where a single minor change will bring all the members of the series into harmony, this change is sometimes justified, but such changes as those suggested above by Mr Goodman in regard to the example under consideration, especially where the value of a sign is also in dispute, are not warranted without proof.

The next date is found in glyphs C9, D9, and is 13 Ik —? Mol. Here the numeral attached to the month is not a regular number symbol (dots and bars) and is interpreted 5 by Mr Goodman. In this I am inclined to think he is wrong, as the symbol appears to be the

same as that found in glyph F9, which he interprets 20. His description of the series is as follows:

> Then [after 4 Ahau 8 Cumhu] follows another reckoning of 1–9×2 [1 ahau, 9 chuens, 2 days], succeeded by five unintelligible glyphs, to 13 Ik, 5 Mol. The computation and the 13 Ik are right, but the month should be 20 Chen, as will be seen by reference to the annual calendar. It will be evident pretty soon that the sculptors got their copy mixed up. The 5 Mol should have gone with another date (p. 135).

The intermediate time periods are 1 ahau (of the usual form, *a*, figure 9), 9 chuens, and 2 days:

	Days.
1 ahau	360
9 chuens	180
Days	2
Total	542

As the first date is uncertain, unless the explanation given above be accepted, we must count back from 13 Ik 20 Mol, which falls in the year 10 Akbal. I use 20 Mol, as I believe 20 to be the true interpretation of the unusual number symbol, and it is really that adopted by Mr Goodman in his calculation, though not expressed. As 20 Mol is the one hundred and sixtieth day of the year, and the count is backward, we subtract this from 542, and divide the remainder by 365, which gives 1 year and 17 days; this brings us to the year 8 Ben. Deducting 5 for the intercalated or added days, and counting back 12 days from the end of the month Cumhu, we reach 4 Ahau, the eighth day of the month Cumhu, proving that this terminal date of the preceding series is correct and that the error of that series must be in the initial date or in the numerals attached to the intermediate time periods. This result is in fact the same as that obtained by Mr Goodman, who commences his count of the days of the month with 20, transferring the last days of the columns in our table 1 to the first place, as is shown in table 4, given below, which is simply a condensation of his "Archaic annual calendar," where each of the fifty-two years is written out in full.

TABLE 4

Ik years	Manik years	Eb years	Caban years	Day numbers													Days of the month
Ik	Manik	Eb	Caban	1	8	2	9	3	10	4	11	5	12	6	13	7	20
Akbal	Lamat	Ben	Ezanab	2	9	3	10	4	11	5	12	6	13	7	1	8	1
Kan	Muluc	Ix	Cauac	3	10	4	11	5	12	6	13	7	1	8	2	9	2
Chicchan	Oc	Men	Ahau	4	11	5	12	6	13	7	1	8	2	9	3	10	3
Cimi	Chuen	Cib	Imix	5	12	6	13	7	1	8	2	9	3	10	4	11	4
Manik	Eb	Caban	Ik	6	13	7	1	8	2	9	3	10	4	11	5	12	5
Lamat	Ben	Ezanab	Akbal	7	1	8	2	9	3	10	4	11	5	12	6	13	6
Muluc	Ix	Cauac	Kan	8	2	9	3	10	4	11	5	12	6	13	7	1	7
Oc	Men	Ahau	Chicchan	9	3	10	4	11	5	12	6	13	7	1	8	2	8
Chuen	Cib	Imix	Cimi	10	4	11	5	12	6	13	7	1	8	2	9	3	9
Eb	Caban	Ik	Manik	11	5	12	6	13	7	1	8	2	9	3	10	4	10
Ben	Ezanab	Akbal	Lamat	12	6	13	7	1	8	2	9	3	10	4	11	5	11
Ix	Cauac	Kan	Muluc	13	7	1	8	2	9	3	10	4	11	5	12	6	12
Men	Ahau	Chicchan	Oc	1	8	2	9	3	10	4	11	5	12	6	13	7	13
Cib	Imix	Cimi	Chuen	2	9	3	10	4	11	5	12	6	13	7	1	8	14
Caban	Ik	Manik	Eb	3	10	4	11	5	12	6	13	7	1	8	2	9	15
Ezanab	Akbal	Lamat	Ben	4	11	5	12	6	13	7	1	8	2	9	3	10	16
Cauac	Kan	Muluc	Ix	5	12	6	13	7	1	8	2	9	3	10	4	11	17
Ahau	Chicchan	Oc	Men	6	13	7	1	8	2	9	3	10	4	11	5	12	18
Imix	Cimi	Chuen	Cib	7	1	8	2	9	3	10	4	11	5	12	6	13	19

It will be seen from this that 13 Ik, the last day of the month Mol (year 10 Akbal) in our table 1, by the change made by Mr Goodman becomes the 20th day of the month Chen, which is in fact the beginning day of this month, and would in all ordinary calculations be counted the first, or 1.

Although the numbering of the days of the month and of the days is not changed by this transposition, it does make a change in two important respects. First, the days which would be last in the month, if the count of the days of the month began with 1, become the beginning days of the following month, though counted as the 20th by Goodman's method. Second, the position of the years in the 52-year period is changed. For example, the year 10 Akbal of the series examined, which will—as can be seen by reference to table 3—be the 49th year of the 52-year cycle, becomes the 9th by Goodman's method.

In the preface or preliminary remarks to his Archaic Annual Calendar, this author states as follows:

> I have put Ik at the head of the days because it is nearest to Kan of any of the Archaic dominicals, and because the Oaxacan calendar shows a tendency toward retrogression in the order of the days. There is no good reason, however, why any of the other dominicals may not have been the first. In fact the frequent and peculiar use of Caban in the inscriptions and its standing as the unit of the numeral series constituted by the day symbols would appear to go far toward justifying an assumption that it was the initial day; but the former circumstance may be only a chance happening, and the latter may attach to the remote pre-Archaic era when the year began with the month Chen; so that neither of these considerations, nor the significant recurrence of Manik in certain places, has had weight enough to induce me to change the order originally adopted; nor will it be worth while to alter it until some style of reckoning from the beginning of the annual calendar is discovered not in harmony with the present arrangement.

In regard to these statements, it may be affirmed that the reason given for placing "Ik at the head of the days" is wholly insufficient, as it is not, in fact, nearest Kan of any of the Archaic dominicals, being nearer to Akbal, which certainly was a dominical, than to Kan; nor, in fact, would this be any reason for the change were it true. Second, as he begins the count of the days of the month with 20, it is in fact not first in the count. It is proper, however, to add here that if Dr Brinton (The Native Calendar, p. 22) has interpreted correctly his authorities, Ik was the initial dominical day in the Quiche-Cakchiquel calendar, though it must have been in comparatively recent times, as will appear from what follows farther on. Mr Goodman's remark that "there is no good reason, however, why any of the other dominicals may not have been first" is certainly correct. But this statement involves the correctness of his entire calendar system so far as the determination of the position of dates is concerned. It is true, as he states in the paragraph next below that quoted, that

"for all ordinary purposes the point of beginning is of no importance, since the annual calendar is only an orderly rotation of the days until each of them with the same numeral has occupied the seventy-three places allotted to it in the year," if "all ordinary purposes" be limited to finding the beginning, closing, and length of periods without regard to the absolute position in the higher Mayan time periods.

To illustrate, I take the last day of the series just examined. If the dominical days be Akbal, Lamat, Ben, Ezanab, in the order given, as first declared by Seler, this day will be 13 Ik, the 20th day of Mol in the year 10 Akbal, and the forty-ninth year of the 52-year period, where the count is by true years, and the 52-year period begins with the year 1 Akbal. According to Mr Goodman's system, using Ik, Manik, Eb, and Caban as the dominical days in the order given (20 Ik being first in the 52-year period), counting the beginning day of the months as the 20th, it would be (though absolutely the same day in time) the 20th day of the month Chen in the year 9 Ik, the 9th year of the 52-year period.

It is undoubtedly true that if the days were written out in proper succession with the proper numbers attached and the months properly marked, as in my Maya Year, we might, if the series should be made of sufficient length, begin the cycle at any point where we could find a day numbered 1 and standing as the first (beginning) day of the month Pop. But the cycles of years beginning at different points would not coincide with one another unless they were exactly 52 years, or a multiple of 52 years, apart.

As the system has, for the periods above the year, no fixed historical point as a basis or guide, the dates are only relative, that is to say, a date though readily located in the 52-year period, unless connected with some determinate time system, may refer to an event that occurred 200, 500, or 5,000 years ago; in other words, is but a point in each of an endless succession of similar series.

It is possible, after all, that Goodman and I are both in error as to the initial year of the 52-year period, though this will in no way affect the calculation of series and determination of dates. The result in these calculations will be the same with any year as the initial one, provided that the regular order of succession be maintained. If the ordinary calendar among enlightened nations had nothing fixed by which to determine relative positions in time, our centuries might be counted from any one selected year, and all calculations made would be relatively correct.

Although Mr Goodman's computations may be, as we shall doubtless find them as we proceed, usually correct, yet there is, if I read him aright, one radical error in his theory. He has taken the apparatus, the aid, the means which the Mayas used in their time counts as, in reality, their time system. In other words, he has taken the

calculation as the thing calculated. He makes the statement, already quoted:

> It was taken for granted that a year of 365 days must necessarily enter into the reckoning; whereas, the moment the Mayas departed from specific dates and embarked upon an extended time reckoning, they left their annual calendar behind and made use of a separate chronological one.

It is the error made in this statement that vitiates the entire stupendous fabric he has built upon it, though all of his computations may be correct so far as calculation is concerned. The Maya, in order to calculate time, had necessarily, just as any other people, to use some system of notation. Maudslay, though usually so carefully conservative, seems to have been led astray in this matter, as he remarks:

> All the dates and reckonings found on the monuments which can be made out by the aid of these tables are expressed in ahaus, katuns, etc., and not in years; but Mr Goodman maintains that the true year was known to the Mayas, and that it is by the concurrent use of the chronological and annual tables that the dates carved on the monuments can be properly located in the Maya calendar.

Dr Förstemann and Dr Seler seem also to have missed the true signification of this time counting. If the former intended to be understood, in suggesting an "old year" of 360, that this number of days was at an early period in the history of the Mayan people actually counted as a year, as seems to be a fair inference from his language, it follows as a necessary consequence that the years and also the months always commenced with the same day, though not with the same day-number (Zur Entzifferung der Mayahandschriften, IV, 1894, and elsewhere). Although Dr Seler distinguishes the 360 days from the true year of 365 days, he alludes to it as a real time period. Speaking of the "katun," he says:

> And hence the discussion—upon which many profitless papers have been written—whether the katun is to be considered 20 or 24 years. The truth is, it consists neither of 20 nor of 24 years—the years were not taken into account at all by the old chroniclers—but of 20 x 360 days.

His katun was therefore 7,200 days, the same as that afterwards adopted by Mr Goodman.

As a Mayan date is properly given when it includes the day and day number, and the month and day of the month, this determines the year in the system and the dominical day. As dates are found in the oldest inscriptions and in the Dresden codex, the oldest, or one of the oldest codices, and these dates show beyond question a year of 365 days, and hence a four-year series, there is no reason for believing that there are allusions, either in the inscriptions or codices, to a year of 360 days. The simple and only satisfactory explanation is that the 360 is a mere counter in time notation.

It would seem, therefore, that Mr Goodman has taken the system of notation in use among the Maya—their orders of units—to be, in reality, their chronological system. It would be just as true to say that the system of notation adopted by most enlightened people—the units, tens, hundreds, thousands, millions, etc., used in calculating periods of time—is, in fact, their time system. The Maya never left their annual calendar behind them when embarking upon extended time reckoning, a fact which is overwhelmingly proved by the constant reference to dates in the codices and inscriptions. The only proof furnished by Mr Goodman as to the reality of his discoveries is based upon this fact. The Maya time counts have only dates of the calendar system in view. Of course the mystical or ceremonial use of the 260-day period is not denied. Were it otherwise, their counting up of high numbers would have no more meaning than the figuring of schoolboys to see what great numbers they could reach. However, additional evidence of the correctness of this assertion will become more apparent when I come to the examination of the characters and numbers which Goodman assigns to his highest Mayan time periods. But in the meantime, though pointing out his fundamental error in this respect, we must not lose sight of his real and important discoveries, which must have a material bearing on all future attempts at interpretation of the codices and inscriptions.

Continuing our examination of the inscription of the Palenque Tablet of the Cross, and starting now from our last date, 13 Ik 20 Mol, in the year 10 Akbal (as I have interpreted it), we take up the succeeding series, explained by Mr Goodman as follows:

> After half a dozen glyphs, unintelligible further than like most intervening characters they are to be found elsewhere in the lists of period symbols, there is another reckoning—1–18–3–12×20 from the preceding date to 9 Ik 15 Ceh [3 left slab]. This is correct, and in connection with the previous reckoning it proves conclusively that the preceding date should be 13 Ik 20 Chen (p. 135).

This "reckoning" signifies 1 cycle, 18 katuns, 3 ahaus, 12 chuens, and 20 days. Here, however, occurs again at the left of the chuen symbol the same character as that at the left of D1 mentioned above, which we counted as 0 instead of 20, as interpreted by Goodman. We count it as 0 in this instance also:

	Days
1 cycle	144,000
18 katuns	129,600
3 ahaus	1,080
12 chuens	240
Days	0
	274,920

Following our own count as given above from 20 Mol, let us see what the result will be. From the total (274,920 days) we subtract 14

calendar rounds or 265,720 days, leaving a balance of 9,200 days. Subtracting from this 205, the remaining days of the year 10 Akbal, and dividing the remainder by 365, we obtain 24 years and 235 days, or 11 months and 15 days. Referring to table 3, and counting forward 24 years from 10 Akbal and passing to the year following, we reach 9 Lamat. By table 1 we find that the 15th day of the 12th month of the year 9 Lamat is 9 Ik, the 15th day of the month Ceh. This is correct, and proves (what Mr Goodman also claims for his count) that our decision as to the dates and the naught symbol is also correct. We pass to the series which follows (4, left slab). This is described by Mr Goodman thus:

> Six unintelligible glyphs follow; then there is a reckoning of 2–1–7–11×2, succeeded by four directive signs, to 9 Ik 20 Zac. I call attention to the directive signs. Two of them are the bissextile character and its coadjutor, which I think are employed in Palenque to denote different numbers of calendar rounds. These should denote fifteen, if intended to indicate the length of the reckoning; if to express an additional period, it is uncertain how many. The other two directive signs are identical with two of those used after 1 Ahau 18 Zotz to show the reckoning is from that date. This reckoning is also from that date; hence the glyph consisting of a bird's head and two signs for 20 over it probably indicates an initial date, or a substitute for it, as 1 Ahau 18 Zotz would appear to be in this case. The month symbol is wrong here also. It should be Yax instead of Zac.

The next date is at E9, F9, which, as there given, appears to be 9 Ik 20 Zac, and the series is 2 days, 11 chuens, 7 ahaus, 1 katun, and 2 cycles at E5 to F6, the symbols being of the usual form. As this will not connect 9 Ik 20 Zac with the preceding date, 9 Ik 15 Ceh (E1 F1), we will reckon from 1 Ahau 18 Zotz (A16 B16), as Mr Goodman suggests. This date falls in the year 2 Akbal.

The count 2–1–7–11×2, when converted into days, is as follows:

	Days
2 cycles	288,000
1 katun	7,200
7 ahaus	2,520
11 chuens	220
2 days	2
Total	297,942

Subtracting from this 15 calendar rounds—284,700 days—we get 13,242 days. Subtracting from this 287, the remaining days of the year 2 Akbal, after 1 Ahau 18 Zotz, and dividing the remainder by 365, we obtain 35 years and 180 days, or 9 months. Counting 35 years from 2 Akbal, on table 3, we reach 11 Ezanab. As the next year will be 12 Akbal, by counting on table 1 nine months in this year, we reach 9 Ik, the 20th day of the month Chen. This corresponds with the inscription except as to the month, which is 20 Zac. The count as given by Mr Goodman is 20 Yax, which is identical in his system with 20 Chen according to the system I am following. His

suggestion, therefore, that the reckoning is to be from 1 Ahau 18 Zotz appears to be correct; at least it connects this date with that following the series, when allowance for the correction mentioned is made.

Although this irregularity, of taking the series step by step from a given date for a time and then skipping back to another date as the starting point, arouses suspicion of something wrong in the proceeding, yet it occurs more than once both in the inscriptions and codices, and hence is not necessarily an evidence of error. The two dates which precede the first series indicate two points from which the count in some of the following series is to begin. Did we fully understand the intermediate glyphs, we should probably find this explained; at any rate we must follow at present what seems to be the most probable rule, trusting that future investigation may correct any errors into which we have fallen. Mr Goodman, who has sought to learn the meaning of what he calls directive signs, says in regard to those connected with this series, "Two directive signs are identical with two of those used after 1 Ahau 18 Zotz to show the reckoning is from that date." There is, however, but one that is similar, and it is an oft-repeated glyph. At any rate the proper result appears to be 9 Ik 20 Chen in the year 12 Akbal, as in no possible way can 9 Ik 20 Zac, which falls in the year 11 Akbal, be reached; and the day 20 Zac in the year 12 Akbal is 3 Ik, whereas the plan of the series appears to require 9 Ik. That the count should be from 1 Ahau 18 Zotz—that is, 1 month back of 8 Ahau 18 Zotz—or that the 11 chuens in the numeral series should be 10, is shown in another way, thus: To obtain the lapse of time from the last preceding date, 9 Ik 15 Ceh, we deduct 9,200 days (third series) from 13,242 (fourth series), and from this deduct 2,982 (first series), over which, as we have seen, the count skipped; this leaves 1,060 days. Counted forward from 9 Ik 15 Ceh (year 9 Lamat), this number of days brings us to 3 Ik 20 Yax in the year 12 Akbal, just 1 month later than 20 Chen. This calculation is based on 8 Ahau 18 Tzec as the starting point; hence we must count from 1 Ahau 18 Zotz, or assume that the 11 chuens in the numeral series should be 10. That the 20 Zac is wrong seems to be evident. Basing the count on 4 Ahau 8 Cumhu and 8 Ahau 18 Tzec will bring the same result, as will be seen by subtracting 2,440 from 13,242 and counting forward from the former.

The series (5 of the left slab) following the last date—9 Ik 20 Chen—as corrected, is described by Mr. Goodman as follows: "The reckoning which follows, 3–6–10–12×2, from the beginning of the great cycle is correct. It is here the 5 Mol should have gone, that being the month date." These number symbols, 3 cycles, 6 katuns, 10 ahaus, 12 chuens, 2 days, which amount to 479,042 days, are followed at F12 by 9 Ik without any accompanying month symbol. The cycle and ahau symbols in this instance are face forms. By assuming as the month

date 5 Mol, and counting back, Mr Goodman reaches 4 Ahau 8 Cumhu—D3, F4. That the count backward from 9 Ik 5 Mol will reach 4 Ahau 8 Cumhu is true, but here again is leaping over series as though they were inserted without plan or system. Moreover, Mr Goodman's remark that the count reaches back to the beginning of the great cycle appears to be inconsistent with his own figures unless we change his "full counts" to naughts. The initial series which he gives is, as has been shown, 53–12–19–13–4×20 to 8 Ahau 18 Tzec. Now, from this date—8 Ahau 18 Tzec—to 4 Ahau 8 Cumhu, according to his own count (page 135) is 6–14×20. Let us add these together.

Cycles	Katuns	Ahaus	Chuens	Days
12	19	13	4	20
		6	14	20
13	0	0	2	0

This reckoning runs back beyond the beginning of his 13th cycle, and hence, by his method of stating series, past the beginning of his great cycle, by two months, using his own figures. If the 20 days in the two series had been counted as 0, his calculation would have brought him to the beginning of a great cycle according to his scheme. Although, as has been stated, he does not use the full counts in his calculations, reference is made here to his method of stating numeral series in order to guard students from being led into error thereby. In every case where he uses 20 for days, ahaus, or katuns, and 18 for chuens, the true figure is 0.

Another fact to be taken into consideration in deciding whether the evidence in the last count is satisfactory is that, as Ik might fall on the 5th, 10th, 15th, or 20th of the month and any one of the months might be chosen, there are 72 (4×18) variations to be tried to bring it into accord with the preceding date. If it could be connected by a following numeral series with some other date, the evidence would then be entirely acceptable, but this does not appear to be the case.

However, I am not entirely satisfied with the result in this case, as the omission of the month date seems to imply that the 9 Ik is to fall on the 20th day of the month. If we follow the same rule as in the two preceding series, and subtract the 4th (297,942 days) from the 5th (479,042), and from the remainder the first numeral series, taking off the one month as before, and counting from the last preceding date—9 Ik 20 Chen as corrected—we reach 9 Ik 20 Mol, year 6 Akbal. Or, subtracting the first series from the 5th (the 4,542) and counting forward from 1 Ahau 18 Zotz, we reach 9 Ik the 20th day of the month by dropping the same troublesome one month. These facts lead me to suspect that the true solution of the problem has not yet been reached.

Following the last date, after some five unknown glyphs are passed, comes, at F15, F16, the numeral series (6, left slab) 13 days, 7 chuens,

6 ahaus, 1 katun, equal to 9,513 days. As no date appears in the remainder of the columns of this left slab, the question arises, Is the left inscription complete in itself and this the close, or is there connection with that of the middle space or right slab? This question will be discussed a little farther on. However, it may be stated here that by using the last (tenth) numeral series on the right slab (7,002 ? days) and counting forward from 1 Ahau 18 Zotz 2 Akbal, of the left slab, we reach 9 Ik 5 Mol 8 Ezanab, of the fifth series of the left slab; but this would seem to be an accidental coincidence.

As additions to the evidence already adduced in regard to the use of face characters to represent numbers, attention is called to others on this slab in regard to which there can be no question. One of these representing the ahau, or third order of units, is seen at F10; one denoting the cycle, or fifth order of units, at F11; another representing the ahau is seen in front of the anklets of the left priest at L13, and another denoting the katun or cycle is under the feet of the left priest.

The inscription in the middle space begins with the date 9 Akbal 6 Xul—including the two glyphs G and H above the head of the left priest. These are distinct, and are probably to be accepted as correct, as the inscription in the middle space of the Tablet of the Sun, which appears to be similar in several respects to that on this tablet, begins with precisely the same date, in the same relative position. The numeral series (1) which follows consists of glyphs L12 and L13, immediately in front of the anklets of the left priest. These are 17 days, 8 chuens, 1 ahau, which equal 537 days. It is possible, however, that the large glyph on which the left priest is standing, which indicates 9 katuns or 9 cycles, is to be included in this series. If they are katuns, then the total number of days is 65,337, from which deducting three calendar rounds (56,940 days), leaves 8,397 days to be counted; if they are cycles, the total number of days is 1,296,537, from which deducting 68 calendar rounds (1,290,640), leaves 5,897 days. The date which follows at glyph L14 is 13 Ahau and apparently 18 Kayab ? or Xul? or possibly Kankin, though the month symbol can not be determined with positive certainty by inspection of the photograph or of Maudslay's drawing. The corresponding date in the Sun Tablet is 13 Ahau 18 Kankin; and what is worthy of notice is that counting forward 537 days from 9 Akbal 6 Xul, year 8 Ezanab, brings us to 13 Ahau 18 Kankin, year 9 Akbal; this is probably the correct date. Using the katuns or cycles we can make connection with none of the given dates; hence the glyph on which the priest is standing may be omitted from the numeral series. Neither 9 Akbal 6 Xul, nor 13 Ahau 18 Kankin, nor 13 Ahau 18 Kayab will connect with any of the dates on the left slab by any of the numbers given.

Taking for granted that 9 Akbal 6 Xul is the date intended by the

aboriginal artist to be given at this point, we next try the connections forward.

The other dates and series in the middle space after 13 Ahau 18 Kankin ? (or Kayab ?), already mentioned, are the following: A date at O1, O2 over the hands of the right priest. This is too badly defaced to be determined; all that can be positively asserted is that the number of the day of the month is 3, thus rendering it certain that it must be Ahau, Chicchan, Oc or Men. The number of the day was small, seemingly 3 or 4, but evidently not exceeding 8; Maudslay's drawing gives 8. The corresponding date on the Tablet of the Sun as given by Goodman is 8 Oc 3 Kayab, and the same date is found correspondingly on the Tablet of the Foliated Cross. The next numeral series (2, middle space) is found in the second and third glyphs of column R, immediately behind the shoulders of the right priest. This appears by inspection to be 6 days, 11 chuens, 6 ahaus = 2,386 days. Maudslay, in his drawing of this inscription in part 10 of his work, makes the number of chuens 13, taking for granted, as seems to be indicated, though it is somewhat doubtful, that the two outer dots have been broken away. This would increase the total number of days to 2,426, while the true number appears to be 2,386.

Before attempting to make connections between the dates on the middle space and those which follow we will pass to the columns of the inscription on the right slab. The first date is found in glyphs T2, S3, viz: 11 —? 20 Pop. The day can not be determined by inspection. However, it must be Caban, Ik, Manik, or Eb, these being the only days which fall on the 20th day of the month. The number prefixed to the month in this instance is the full-count or 20 symbol, two semicircles. Before reaching a numeral series another date occurs at glyphs S4, T4, as follows: 5 —? 14 Kayab? The day can not be determined with certainty, but is apparently Cimi, or Cib, most likely the former; the month symbol is somewhat indistinct, but appears to be that of Kayab. The corresponding date in the inscription of the Tablet of the Sun and also of the Tablet of the Foliated Cross is 2 Cib 14 Mol, but in the former it is preceded by 4 Ahau 8 Cumhu, whose position is occupied in the Tablet of the Cross now under consideration by the 5 —? 14 Kayab? above mentioned. There is no recognizable numeral series in the middle space of either the Tablet of the Sun or Tablet of the Foliated Cross, but it is a singular fact that the second numeral series of the middle space of the Tablet of the Cross, given in the above list as 2,386 days, is exactly the lapse of time (counting forward) from 8 Oc 3 Kayab to 2 Caban 14 Mol in the Tablet of the Sun and Tablet of the Foliated Cross, and the 537 days of the first series in this space also connects the first and second dates in the middle space of the Sun Tablet, viz: 9 Akbal 6 Xul and 13 Ahau 18 Kankin. It is possible that these three inscriptions are dependent to some extent one upon the other, or are based upon an older and lost original.

Neither of the two dates preceding the first series of the right slab, as determined by inspection of the inscription, makes a satisfactory connection with any preceding or following date; the proper day, but not the proper number, and even the day of the month, is reached, but there is no complete agreement, nor can the result be followed up with proof of its correctness. If we deduct 8 days from 8,034, the first numeral series of the right slab, and count back from 5 Cimi 14 Kayab 10 Ben, we reach 13 Ahau 18 Kayab 1 Akbal, which may possibly be the correct date following the first series in the middle space. But this will not connect with 9 Akbal 6 Xul by the intermediate 537 days, but with 9 Akbal 6 Chen, year 13 Ezanab. However, if we deduct 8 days from 8,034, leaving 8,026, and count forward from 13 Ahau 18 Kankin, year 9 Akbal, the second date of the middle space, as found by calculation from 9 Akbal 6 Xul 8 Ezanab, this will bring us to 5 Cimi 14 Kankin, year 5 Ben, which may be the second date of the right slab, though the month symbol appears to be that of Kayab, and is so interpreted in Maudslay's drawing. This will change the days of the glyph T4 from 14 to 6, but these are exactly in the line of the break in the slab and have been restored by Dr Rau. Nevertheless, as 5 Cimi 14 Kankin will not connect with any following date by the numeral series as they stand, the result is not satisfactory.

The first date, 11 —? 20 Pop, if construed to be 11 Manik 20 Pop 5 Lamat, will, by counting forward with 15,217, the seventh series, bring us to 5 Kan 12 Kankin, year 7 Ben, the date of the sixth series, except that the month is Kankin instead of Kayab as in the inscription. Can it be that these supposed Kayab symbols should be interpreted Kankin? That some of them differ materially from the others is apparent. If, however, the date is construed to be 11 Ik 20 Pop, year 5 Akbal, and series 2 and 3 (4,749 and 123) be subtracted from the first series (8034), the remainder, 3,162, will, by counting forward, reach 1 Kan 2 Kankin, year 13 Akbal, the date following the first series except as to the month, which in the inscription appears to be Kayab, though uncertain. The day symbol of the first date, 11 —? 20 Pop, does not appear to be Ik, though too nearly obliterated to be determined by inspection. But it appears, on the other hand, as has been stated, that if we assume this first date to be 11 Manik 20 Pop, year 5 Lamat and count forward 15,217 (the seventh series), we reach 5 Kan 12 Kankin, year 7 Ben, date of the sixth series except the month, which is Kayab in the inscription, or what has usually been taken as Kayab, and is of the form given in the Dresden codex to this month symbol. And lastly, it may be stated that Maudslay's drawing is evidently intended to indicate Caban. As neither of these results can be followed up with other satisfactory connections they must be considered as merely accidental coincidences. The same remark applies also to the next date, 5 Cimi (or Cib?) 14 Kayab. Nor can any satisfactory connection be made with the next date—1 Kan 2 Kayab. By

reading it 1 Kan 2 Kankin, connection can be made in the manner mentioned above. If the date of the fifth series, left slab, be construed to be 9 Ik 20 Mol, which it may as well be as 5 Mol, by counting forward 4,542 days we reach 1 Kan 2 Kayab 5 Akbal, the apparently correct date, according to the inscription. If this reckoning be accepted it will form a connection between the inscriptions of the right and left slabs.

The second date following the first numeral series on this slab is found in glyphs S10, T10. This is 11 Lamat 6 Xul, year 10 Akbal; following this, at S12, T12, is the numeral series 9 days, 3 chuens, 13 ahaus, which equal 4,749 days, and following this series, at S14, T14, is the date 2 Caban 10 Xul, year 10 Lamat. The two last-mentioned dates make connection, as by counting forward 4,749 days from 11 Lamat 6 Xul 10 Akbal we reach 2 Caban 10 Xul in the year 10 Lamat. Immediately following the last-mentioned date, at S15, is the short numeral series (3, right slab), 3 days, 6 chuens, or 123 days, which, counting forward, bring us to 8 Ahau 13 Ceh, year 10 Lamat, the date which follows at T17, U1. The rule therefore holds good as to these dates and the two intervening numeral series. It would seem to follow, therefore, that the arrangement or plan of the series on this slab, when found, should coincide with the determination as to these two series; but from this point to the end of the inscription there is no connection of dates—with possibly one exception—without some change in dates or numbers from what they appear to be by inspection, or change in the direction of the reckoning. I shall therefore note the position of the dates and series which have been mentioned in the preceding list, and then add some remarks in regard to the relation of the dates and series to one another. I do this because Mr Goodman has left unnoticed the series of the inscription on this right slab, possibly because of the difficulty and seeming impossibility of bringing them into harmony with his theory.

Immediately following the last date mentioned there is at U2 a symbol denoting 9 cycles, or ninth cycle, but judging by the rule adopted by Mr. Goodman this is not to be considered a part of the numeral series (4) which follows immediately after at U3 to U4, viz, 18 days, 1 chuen, 8 ahaus, 1 katun=10,118 days. At U7, V7 is the date 3 Ezanab 11 Xul, the day somewhat indistinct, but so rendered, apparently correctly, by Maudslay. Following this at U8, U9 is the numeral series (5), 18? (or 17?) days, 10? (or 8?) chuens, 16 ahaus, 1? katun. The numbers of this series in the inscription have been injured to such an extent as to render uncertain those marked as doubtful; the number of days is assumed to be 13,138, which is probably correct, but the error, if there be one, is such that it should be readily discovered by means of connecting series, if these be correct.

Following the last series, at U10, V10 is a date so nearly obliterated

that it can not be determined (except the numerals) with positive certainty; it appears to be 5 Ahau 3 Tzec. Glyphs V12, U13 give another date, 5 —? 20 Zotz. The features of the day symbol are completely obliterated; the prefix to the month glyph is the symbol for 20. Immediately following, at V13 V14, is the series (6) 16 days, 6 chuens, 19 ahaus, 1 katun (14,176 days); at U17, V17 the date 5 Kan 12 Kayab; at W1, W2 the series (7) 17 days, 4 chuens, 2 ahaus, 2 katuns (15,217 days); at X5, W6 the date 1 Imix 4 Ceh (or Zip), month symbol somewhat doubtful, but one of the two named, apparently Ceh. Following this at X6, W7 is the brief series (8) 1 day, 1 chuen, 1 ahau (381 days), followed at X10, W11 by the date 7 Kan 17 Mol; this is followed at X11, X12 by the series (9) 7 days, 4 chuens, 8 ahaus, 2 katuns (17,367 days); following this at W14, X14 is an uncertain date—11 Cib, Cimi, or Chicchan, 14? (or 13?) Kayab? The day symbol and its number are distinct and clear, but the symbol is unusual; the number prefixed to the month symbol has been partially broken away; there were certainly two lines (10) and some two, three, or four balls. The month symbol is uncertain, but is apparently the same as that of the date 13 Ahau 18 Kayab? or Xul, in column L, though it has something additional on top. It is possible the symbol is intended for Chen or Kankin.

Following the last date (11 Cib?) at W15, X15 is the series (10) 2 days, 8 chuens, 16, 17, 18, or 19 ahaus. The three lines (15) prefixed to the ahau symbol are distinct, but the additional balls or dots have been injured to such an extent as to render the number uncertain (7,002 days, counting 19 ahaus). There is no date or other series in the remaining portion of the inscription.

If it be possible to determine the plan, succession, or arrangement of the series in this inscription, an important step will have been gained and a basis laid for the correct determination of the associated glyphs. The peculiarities of Mayan time system and notation so often lead to deceptive results that extreme caution is required, and a single connection or proper result is seldom sufficient evidence of a correct interpretation.

Taking the list of the series as given we are at once impressed with the strong general resemblance to the plan of the series on many of the plates of the Dresden codex, where several different series are found, some reckoned in one direction and some in another, as, for example, plate 73, where there are one entire series, parts of two others, and dislocated parts of two; or plate 70, where there are, in whole or in part, some half dozen series still in a tangle which has not yet been straightened out; also other plates.

Taking merely the numerical series in the order they stand and changed to days, there is certainly in the irregularly ascending scale an indication of arrangement, of and relation between the series.

These, beginning with the first in the middle space and following with the right slab and then with the left, are as follows:

Middle space

1.....	537
2.....	2,386?

Right slab

1.....	8,034
2.....	4,749
3.....	123
4.....	10,118
5.....	13,138
6.....	14,176
7.....	15,217
8.....	381
9.....	17,367
10.....	7,002?

Left slab

1.....	2,980
2.....	542
3.....	274,920
4.....	297,942
5.....	479,042
6.....	9,513

It is apparent from this list that there is an irregularly aseending scale following the order given, but so far no common divisor forming a basis of the differences has been found; moreover, the introduction at some three or four points of short periods seems to break in upon the idea of special references to the differences, as is usual in the Dresden codex. Besides this, the differences do not serve to connect dates, except possibly in two instances, while in one-third or more cases successfully traced individual numeral series do.

As the exceptions alluded to above may possibly prove to be important factors in determining the relations of the series on this tablet, it will not be amiss to again notice them here.

As is shown above, if we add two days to the first numeral series on the left slab, making it 2,982, and count forward from 8 Ahau 18 Tzec (2 Akbal), we shall reach 13 Ik 20 Mol (10 Akbal), the date following the second numeral series. If now we add the first numeral series as corrected—2,982—to the third numeral series (after deducting calendar rounds)—9,200—making a total of 12,182, and count forward this number of days from 8 Ahau 18 Tzec (2 Akbal), we reach 9 Ik 15 Ceh (9 Lamat), the date following the third numeral series. If we go back now and subtract the second numeral series—542—from the first—2,982—which leaves 2,440 days, and count forward this number of days from 8 Ahau 18 Tzec (2 Akbal), we reach 4 Ahau 8 Cumhu

(8 Ben), the date following the second numeral series. These agreements can scarcely be accidental, and if not, they establish two facts: First, that Goodman's interpretation of the face glyphs giving the date 8 Ahau 18 Tzec is correct, or at least brings a correct result; and, second, that the emendation of the first numeral series by adding 2 days is also correct. Other relations of dates on the left slab have been given, besides which no further connection by using the differences of the numeral series can be obtained.

Turning to the right slab, if, as has been suggested, we assume the first date (11 — ? 20 Pop) to be 11 Ik 20 Pop (year 5 Akbal), and subtract series 2 and 3 (4,749 and 123) from the first series (8,034), the remainder, 3,162, counting forward from 11 Ik 20 Pop (5 Akbal) will bring us to 1 Kan 2 Kankin 13 Akbal, the date following the first numeral series, if the month symbol is interpreted Kankin instead of Kayab. This result, however, is not so satisfactory as that of the left slab, as the day in (11 — ? 20 Pop) does not appear to be Ik, though indeterminable by inspection; but it has been referred to in connection with the reckoning in regard to the inscription onthe left slab, as it may tend to show that these minor series are to be deducted in tracing connection of the dates.

After a somewhat lengthy and careful study of the inscription on this tablet, testing the relation of the series by calculation in every possible way, I have failed to find any satisfactory evidence of connection in a continuous line. The indications point rather to two or more parallel lines. There are, however, difficulties in the way of obtaining a clear understanding of the plan adopted by the original artist which I have been unable to overcome, so great, in fact, that were it not for other evidence, the correctness of Goodman's theory in this respect would be left in doubt. It was probably on account of these difficulties that this author omitted any reference to the inscription on the right slab, the best known and most accessible to students of all the Central American inscriptions. Some indications of different lines of series are found in the overlapping of reckonings in the inscription of the left slab already given.

At glyph U2 of the right slab, immediately after the date 8 Ahau 13 Ceh which follows numeral series 3 of this slab (see list of series above), is the symbol for 9 cycles, which, as we have stated, is not connected with any numeral series. This is, as will be found in other instances, probably intended to indicate that at this point 9 cycles have been completed from 4 Ahau 8 Cumhu, the date following series 1 of the left slab. The day 8 Ahau 13 Ceh is the first day of the 10th cycle as given in Goodman's chronological calendar. It is, however, certain that all the numeral series preceding it on the tablet fall short of amounting to 9 cycles. Moreover, some of them appear, as has been shown, to reach back over others, thus lessening the number to be

actually counted. These facts seem to indicate that there is some omission, in truth a very large one; but with our present knowledge we are unable to solve the problem.

I have already alluded to the question of connection between the left and right slabs, direct, or by means of the characters in the middle space. Mr Goodman evidently follows the idea that the beginning of the inscription on the right slab (six columns) follows directly the close of that on the left slab. He does not make this plain in his notes on this tablet (op. pp. 135, 136), but when his remarks and figure on a previous page are considered (p. 96) it becomes evident, as the two upper glyphs of this figure are the last (E17 and F17) of the inscription on the left slab, and the other three the first three (S1, T1, and S2) in the inscription on the right slab. In connection therewith he remarks as follows:

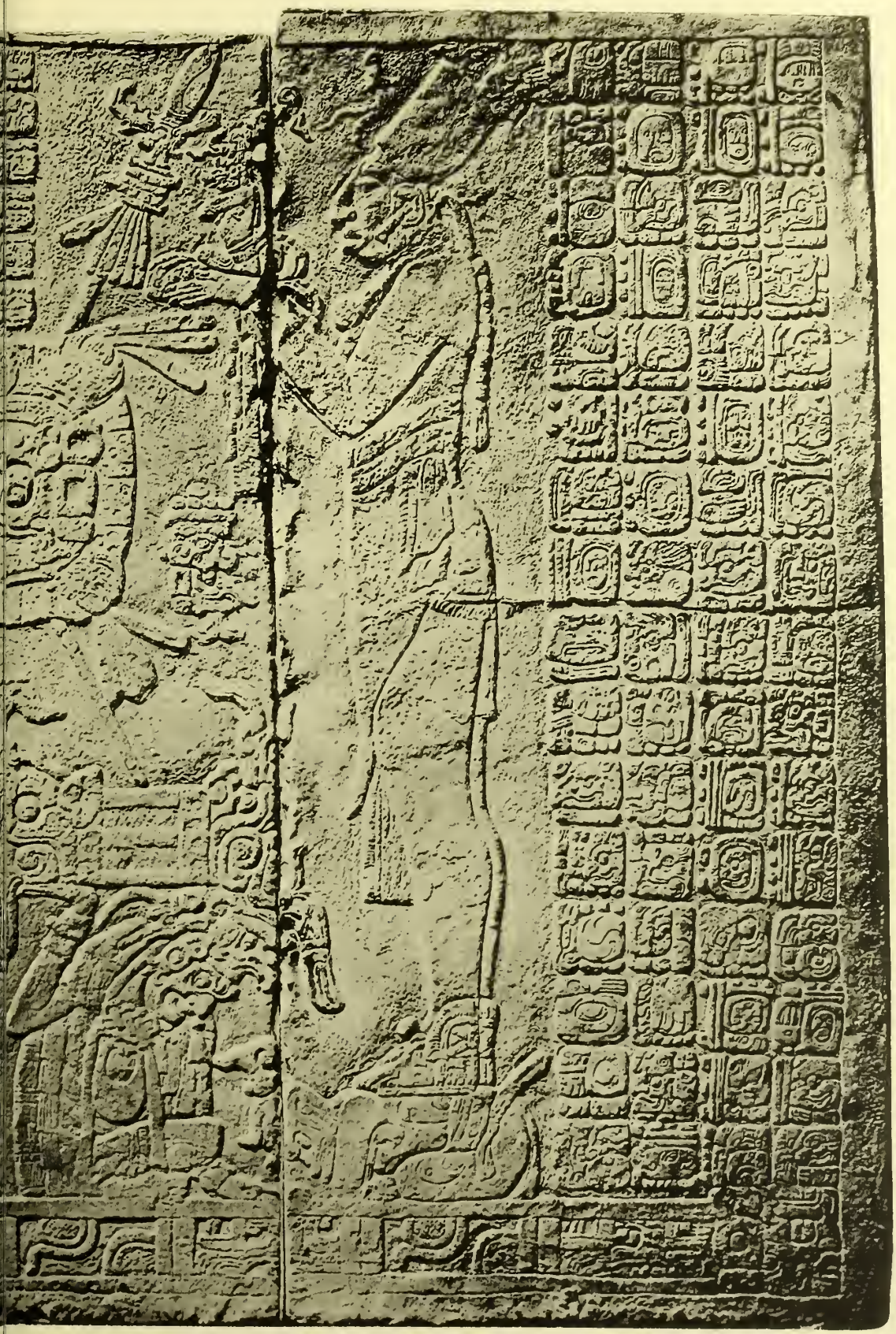
> The reckoning here is from the beginning of a great cycle. A notation of 1–6–7×12 (the 12 erroneously appears as 13) precedes the glyphs and is to be incorporated with them. The reckoning shows the difference between the dates in the annual calendar.

His reckoning (1–6–7×12) is 1 katun, 6 ahaus, 7 chuens, 12 days = 9,512 (given in the sixth series of our list of the left slab as 9,513). If it were true, as he states, that the "reckoning shows the difference between the dates of the annual calendar," meaning the date preceding and that following the numeral series, this would be strong proof of connection, but unfortunately Mr Goodman is mistaken in this instance, as neither the last preceding date (9 Ik 5 Mol), nor the initial date, nor any other date of the left slab connects by 9,512 or 9,513 with either of the first two dates of the right slab, or any other date thereon. If there be any connection between the dates in the different spaces, it is between those of the middle space and those of the right slab, reading forward, and the last date on the inscription of the right slab and one of those on the left.

It is evident from what has been shown that the proof of Mr Goodman's theory, drawn from the Tablet of the Cross, is not very satisfactory, as not more than one-third of the dates thereon can be connected thereby. But where two and three series connect in succession the probability of the double or treble coincidence is so extremely remote that the theory as to the numeral symbols and their use may be accepted as demonstrated. If the double connection occurred but once in the whole range of the inscriptions it would be best to conclude this to be a mere coincidence, but as this occurs again and again in the inscriptions, and even, as will be seen, a succession of three and four, the proof is too strong to be resisted. Even without this mathematical demonstration the strong, in fact, evident resemblance of these numerical series to those of the codices is almost, if not quite, sufficient to justify Goodman's interpretation of the numeral symbols to which allusion has been made.

TEMPLE OF THE SUN. THE INSCRIBED PAN

PHOTOGRAPHED FR



ON THE BACK WALL OF THE SANCTUARY.

A PLASTER CAST.

TABLET OF THE SUN

We turn to the inscription on the Tablet of the Sun—of which we also have a photograph by Mr Maudslay, shown in our plate XLI—and to Mr Goodman's comment, which is as follows (page 136):

Initial date: 54–1–18–5–3×6–13 Cimi 19 Ceh. The month symbol comes after one of the glyphs of the initial directive series. A reckoning of 1–2×11, with three unintelligible glyphs following, points to a date which appears to be 1 Caban 10 Tzec; but as that is not the date to which the intelligible part of the reckoning would lead, both the date and direction are uncertain. Thirteen glyphs follow, some of them of recognizable purport, but the exact meaning of which in this connection I do not know. Then comes a restatement of the initial reckoning, 1–18–5–3×6, from the beginning of the great cycle, followed by nine glyphs whose use here is unintelligible, though four of them are signs with whose meaning we are acquainted. Next in order comes a reckoning of 9–12–18–5×16 (followed by four glyphs nearly identical with a series in the preceding inscription), from 4 Ahau 8 Cumhu, the beginning of the great cycle, to 2 Cib 14 Mol. This is correct. After five incomprehensible glyphs occurs the date 3 Caban 15 Mol. In the annual calendar the last two dates adjoin each other, but whether the latter is here intended to be the succeeding day, or whether some calendar rounds are indicated by the characters preceding it, is something we are at present unable to determine. Sixteen baffling glyphs follow, and then there is a reckoning of 7–6–12×3–12 Ahau 8 Ceh. There are no recognizable directive signs here, but by trial we discover that the reckoning is the distance between 12 Ahau 8 Ceh and 9 Akbal 6 Xul, a date that comes after six intervening glyphs. Eight more unintelligible glyphs occur, and then a reckoning of 6–2×18 (the 18 should be 17), 2 Cimi 19 Zotz. The directive signs are unfamiliar, but as the reckoning is backward to 9 Akbal 6 Xul, they probably denote that fact. Next is 1–8×17, 13 Ahau 18 Kankin, which is declared to be a 10th ahau, the reckoning being the distance from 9 Akbal 6 Xul to that date. Both of these dates are subsequently repeated for some reason, and the record ends with 8 Oc 3 Kayab, followed by ten glyphs whose meaning is not apparent.

This is a puzzling inscription so far as its numeral or time series are concerned, a fact apparent from the comment which Mr Goodman makes on it. Although there are several series with sufficient data for the purpose of tracing them, but few of the dates can be connected, and these not satisfactorily.

The series and dates in the order in which they come in the inscription are as follows, adopting Goodman's interpretation of the initial series:

Left slab

								Days
1	54	1	18	5	3	6	13 Cimi 19 Ceh (9 Lamat)	
2				1	2	11	1 Caban? 10 Tzec (3 Lamat)	411
3		1	18	5	3	6	(No date) (275,466)	9,746
4		9	12	18	5	16	(No date) (1,388,996)	3,456

Middle space

		9 Akbal 6 Xul (8 Ezanab)
1	(Unintelligible)	13 Ahau 18 Kankin (9 Akbal)
		8 Oc? 3 Kayab? (11 Lamat?)

Right slab

					4 Ahau 8 Cumhu (8 Ben)	
					2 Cib 14 Mol (5 Akbal)	
					3 Caban 15 Mol (5 Akbal)	
1	7	6	12	3	12 Ahau 8 Ceh? (6 Ben?) (52,803).....	14,843
					9 Akbal 6 Xul (8 Ezanab)	
2		6	2	18	2 Cimi 19 Zotz (2 Lamat).....	2,218
3		1	8	12	13 Ahau 18 Kankin (9 Akbal).....	532

For convenience of reference the series of each division are numbered at the left; the year to which the date refers is given in parenthesis following the date, and the equivalent in days of the time series—after deducting the calendar rounds where greater than one round—is placed at the right. The positions of the various dates and series in the inscription are given as we proceed.

In this inscription, as that of the Cross, the numbers prefixed to the periods of the initial series are face characters instead of the ordinary number symbols, except the number prefixed to the month symbol Ceh, which consists of the usual lines and dots. This initial series—54–1–18–5–3–6—interpreted, is as follows: The fifty-fourth great cycle, 1 cycle, 18 katuns, 5 ahaus, 3 chuens, 6 days, to 13 Cimi the 19th day of the month Ceh. Mr Goodman's interpretation of this inscription, so far as it extends, is given above. It appears that he places, as seems to be his rule, the inscription in the middle space after that in the right slab. It is possible, as is indicated by what follows, that he is right in this instance.

That 13 Cimi 19 Ceh, the first date, will not connect with the next date by 1 ahau, 2 chuens, 11 days (411 days), the second numeral series (in reverse order)—glyphs A13, B13—is certain, as the reckoning brings us by counting forward to 8 Caban 5 Muan, year 10 Ben. Yet, notwithstanding the radical error on the part of the original artist implied by the assumption that the last is the correct date here, there are some grounds for the assumption. As there are no more dates on the left slab, Goodman assumes that those attached to the 3d numeral series, which is precisely the same as the initial series, are the same as those which precede and follow that series, viz, 4 Ahau 8 Cumhu, beginning of the 54th great cycle, and 13 Cimi 19 Ceh. But this result, it must be remembered, is based upon the assumption that Mr Goodman's interpretation "13" Cimi of the first given date is a correct rendering of the face numeral. In this case his determination has been reached not from the details of the face character, but from his theory that his 54th great cycle begins with 4 Ahau 8 Cumhu, as counting forward 1–18–5–3–6 (9,746 days after deducting the calendar rounds) reaches 13 Cimi 19 Ceh (9 Lamat). This is apparent from his statement on page 49 of his work, where he gives figures of face signs for 13:

> I do not know what to conclude about the last face in the list, which is the day numeral in the initial date of the Temple of the Sun, Palenque. It is more like the

chuen sign than any other, but the numeral is unmistakably 13. It is more reasonable to suppose that the sculptor made a mistake in the *kin* sign, than that the chuen symbol should have been used to represent both 13 and 15.

The third number series is found (in reverse order) in glyphs C7, D7, C8, D8, the ahau and cycle symbols—D7 and D8—being face characters.

The fourth series, 9–12–18–5–16, or 9 cycles, 12 katuns, 18 ahaus, 5 chuens, 16 days, is found (in reverse order) in glyphs C14 to C16, inclusive. Here the days are not joined to the chuen symbol as usual, but have a separate symbol (C14), a face character with the number prefixed. The chuen symbol (D14) is also a face character. The series reduced to days is 1,388,996, from which subtracting 73 calendar rounds leaves 3,456 days to be counted. Counting forward this number of days from 4 Ahau 8 Cumhu (8 Ben) the beginning of Goodman's fifty-fourth great cycle, we reach 2 Cib 14 Mol (5 Akbal). Both dates in this instance are found *after* the numeral series and on the right slab—4 Ahau (P2) 8 Cumhu (O3); 2 Cib (O4) 14 Mol (P4.). Placing the dates together before or after a numeral series which denotes the lapse of time between them is unusual, but not without precedent.

Using the last result, we may perhaps find the proper connection with 13 Cimi 19 Ceh, the first given date. Subtracting the third series (275,466 days) from the fourth series (1,388,996 days) leaves 1,113,530 days, from which subtracting 58 calendar rounds (1,100,840 days) leaves 12,690 days to be counted. Reckoning back this number of days (12,690) from 2 Cib 14 Mol (5 Akbal) we reach 13 Cimi 19 Ceh (9 Lamat) the first date of the left slab. Of course it follows that counting forward from 13 Cimi 19 Ceh (9 Lamat), the difference between the third and fourth series, we reach 2 Cib 14 Mol (5 Akbal). Subtracting the third series from the fourth in order to get back to 13 Cimi 19 Ceh is certainly proper, as the former is included in the latter. These results would seem to be correct, and if so, justify Goodman's interpretation "13" of the face numeral joined to Cimi, and form a second connection between the inscriptions of the left and right slabs. However, using the last number, 12,690 less 411 (12,279), and counting back from 2 Cib 14 Mol, we reach 8 Caban 5 Muan (10 Ben) instead of 1 Caban 10 Tzec. As this is, as it should be, also the date reached by counting forward 411 days from 13 Cimi 19 Ceh (9 Lamat), I am inclined to believe that it is correct, and that here the original artist has by mistake given an erroneous date. It is apparent that to use 411 days in counting forward from 13 Cimi 19 Ceh, year 9 Lamat, must of necessity bring us into the year 10 Ben, therefore, as 1 Caban 10 Tzec can not be connected with any other date by subtraction, addition, or skipping, and the date 8 Caban 5 Muan will connect both backward and forward, it may be accepted as probably correct.

As there is no numeral series in the middle space, these may be left

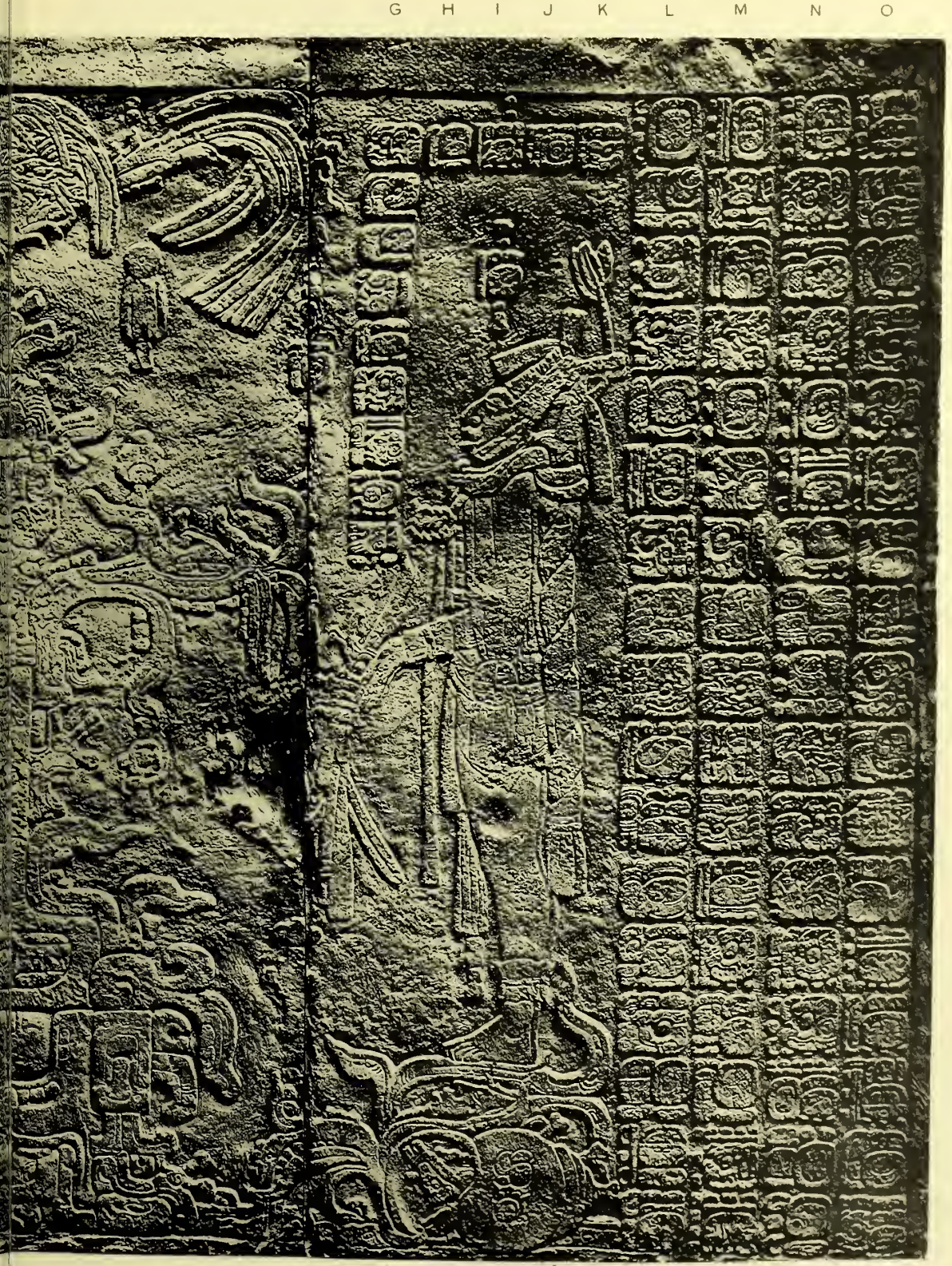
to be determined by the dates, or from the numeral series in the corresponding position in the Tablet of the Cross. Be this as it may, it is certain that the first numeral series in the middle space of the latter tablet—537 days—measures exactly the lapse of time from 9 Akbal 6 Xul to 13 Ahau 18 Kankin of the Sun Tablet; and that 2,386 days, the second series in the middle space of the Tablet of the Cross, is exactly the time from 8 Oc 3 Kayab (middle space) to 2 Cib 14 Mol, second date on the right slab of the Tablet of the Sun. This result, however, would seem to be contrary to the evidence adduced of the direct connection between the inscriptions of the left and right slabs; nevertheless it is a remarkable coincidence which depends on some fact in regard to the series not yet ascertained. Possibly these form a separate succession of series.

I have been unable to find any connection between either of the dates of the right slab which precede the first numeral series and any one which follows. This series in reverse order is 3 days, 12 chuens (glyph P16), 6 ahaus (Q1), and 7 katuns (R1), equal 52,803 days, or, after subtracting 2 calendar rounds, 14,843 days. Using the latter and counting forward from 12 Ahau (Q2) 8 Ceh (R2), year 6 Ben, we reach 9 Akbal (Q6) 6 Xul (R6), year 8 Ezanab. Here also both dates follow the numeral series.

Following the last-mentioned date, at Q11, R11 is the numeral series 18 days, 2 chuens, 6 ahaus, or 2,218 days. This is followed at Q12 R12 by the date 2 Cimi 19 Zotz (year 2 Lamat), which is followed at Q14, R14 by the numeral series 12 days, 8 chuens, 1 ahau (left portion of R14), and this is followed at R14 (right portion) and Q15 by the date 13 Ahau 18 Kankin. It will be observed that two of these dates are the same as the first and second dates of the middle space. It seems from the reckonings which follow that the number of days in the second numeral series should be 2,217 instead of 2,218. Subtracting 2,217 from the first series (14,843), the remainder—12,626 days—exactly measures the lapse of time from 12 Ahau 8 Ceh, year 6 Ben, of the first series, to 2 Cimi 19 Zotz, year 2 Lamat, of the second series. Counting forward 2,217 days from 2 Cimi 19 Zotz we reach 9 Akbal 6 Xul, year 8 Ezanab; this may be the first date in the middle space, and not the 9 Akbal 6 Xul which precedes the second series of the right slab, as Goodman contends, which would be a backward count as stated in the quotation on page 761; or it may be an omitted date. Counting 537 days (532 in third series right slab should evidently be 537, the number given between the same dates in the middle space of the Tablet of the Cross) from 9 Akbal 6 Xul, we reach 13 Ahau 18 Kankin, third series and last date on the right slab; or, adding together the second and third series—the 2,217 and 537, making 2,754 days—and counting forward from 2 Cimi 19 Zotz, year 2 Lamat, we also reach 13 Ahau 18 Kankin. These results seem to justify the slight corrections made in the numerals.

TEMPLE OF THE FOLIATED CROSS. INSCRIBED F

PHOTOGRAPHED FR



PANEL ON THE BACK WALL OF THE SANCTUARY.

FROM A PLASTER CAST.

The data also seem to favor Goodman's conclusions except in one or two cases where his statements are palpably erroneous. He gives 17 as the number of days in the third series right slab without reference to the fact that the inscription shows 12. I think that 17 days are to be counted here, but the inscription shows clearly 12.

TABLET OF THE FOLIATED CROSS

The next inscription to which attention is directed is that on the so-called Tablet of the Foliated Cross. Here we are favored with Mr Maudslay's excellent photograph, of which a copy is given in our plate XLII.

The numeral series and dates in the order in which they stand in the inscription, including the initial series as interpreted by Goodman (except as to the 20 days), are as follows:

Left slab

								Days.
1	54	1	18	5	4	0	1 Ahau 13 Mac (9 Lamat) (275,480)	9,760
2					14	19	1 Cauac 7 Yax (10 Ben)	299
3				1	14	14	0 2 Ahau 3 Uayeb (4 Ezanab)	12,520
							1 Ahau 13 Mac (9 Lamat)	
4			7	7	7	3	16 (no date) (1,060,996)	17,096

Middle space

8 Oc 3 Kayab (11 Lamat)

Right slab

2 Cib 14 Mol (5 Akbal)
3 Caban? 15 Mol (5 Akbal)

1?				6	9	3	(no date; doubtful series though distinct)	2,343
2			2	9	6	4	8 Ahau 3 Uo? (12 Ezanab?) or 8 Oc 3 Kayab	17,764
3				6	11	6	(no date)	2,386
4				1	12	4	8 Ahau 8 Uo? (7 Ben?)	604
5?			13	0	0	0	(no date; probably not a counter)	(17,680?)

As in the lists heretofore given, for convenience the series are numbered at the left, the years are added in parentheses, the number of days are indicated by the numeral series placed to the right, and the remainder is shown after the calendar rounds have been subtracted when the total exceeds a calendar round. In place of the 20 days given by Goodman I have in each case substituted 0 days, as I thus interpret the symbol in the inscription.

As the reader must have the inscription before him to find the position of the numeral series and dates and is presumed now to be sufficiently posted to find them from the list given above, it is deemed unnecessary to give here a list of the glyphs. Such reference to special glyphs as is deemed necessary will be made as we proceed.

The numerals to the time periods in the initial series of this inscription, as in the two which have been examined, consist of face characters,

except the 13 to the month Mac. For their determination we are indebted chiefly to Mr Goodman, the evidence so far as obtained being sufficient to enable us to identify some of them. The date from which this series is counted, the beginning of Mr Goodman's so-called fifty-fourth great cycle, is, of course, 4 Ahau 8 Cumhu, in the year 8 Ben. Counting forward from this date 9,760 days, the number after the calendar rounds are subtracted, brings us to 1 Ahau 13 Mac (9 Lamat), the first recorded date. As it is with the latter date, which is designated the "initial date," though it is not strictly so, that Mr Goodman begins his reckoning, we give here his comment on the inscription:

Initial date: 54–1–18–5–4×20–1 Ahau 13 Mac. This date is just fourteen days later than the initial date of the preceding inscription [Tablet of the Sun]. The directive series follows, succeeded by a reckoning of 14 chuens and 19 days to 1 Cauac 7 Yax. Eleven unreadable glyphs come next, and then 1–14–14×20, which, after four uncertain directive characters, is declared to be a reckoning to the beginning day score of the second cycle, 2 Ahau 3 Uayeb. It is correct. Then come two reckonings in an unfamiliar style, the first from the beginning of the great cycle, the second from 1 Ahau 13 Mac. I am positive of this, for the very next reckoning will show that there are 40,000 days to be accounted for somehow, and they can be represented only by one of these counts. That reckoning is: 7–7–7–3×16, to 2 Cib 14 Mol. Subsequent computations show that date to be the one to which 9–12–18–5×16 led up in the preceding inscription; hence the necessity for something to explain the missing 40,000 days. As from this on the reckoning and dates of the two inscriptions are nearly the same, it is not worth while to repeat them; I will, however, give a synopsis showing the position of the dates in both:

(1)	54	1	18	5	3× 6	13 Cimi 19 Ceh
(2)	54	1	18	5	4×20	1 Ahau 13 Mac
(3)	54	1	18	6	18×19	1 Cauac 7 Yax
(4)	54	2	20	20	18×20	2 Ahau 3 Uayeb
(5)	54	9	3	1	15×20	12 Ahau 8 Ceh
(6)	54	9	10	2	6× 6	2 Cimi 19 Zotz
(7)	54	9	10	8	9× 3	9 Akbal 6 Xul
(8)	54	9	10	10	18×20	13 Ahau 18 Kankin
(9)	54	9	12	11	12×10	8 Oc 3 Kayab
(10)	54	9	12	18	5×16	2 Cib 14 Mol
(11)	54	9	13	20	18×20	8 Ahau 8 Uo

Beginning with the first date, 1 Ahau 13 Mac (which falls in the year 9 Lamat), in regard to which we follow Mr Goodman's determination, the prefixed number and the day also being face glyphs, we count forward 19 days and 14 chuens, or 299 days. This reckoning reaches 1 Cauac 7 Yax in the year 10 Ben. This is correct, as this date is found at B13, A14 immediately following. This result is important, as it furnishes strong evidence of the correctness of the number assigned by Mr Goodman to the face glyph attached to the day Ahau. The reckoning here is forward, which is presumed to be the direction followed by the other series.

As the next numeral series (C3 to D4, reverse of usual order) is, as I

count it, 1 katun, 14 ahaus, 14 chuens, 0 days, or, in all, 12,520 days, the reckoning is forward this number of days, presumably from 1 Cauac 7 Yax in the year 10 Ben. No connection is made by this count; but when 299 days, the amount of the previous series are deducted, the remainder—12,221 days—will carry us to 2 Ahau 3 Uayeb (or the third added day) of the year 4 Ezanab. This is correct, as we find this date following the series at C8, D8. By using the whole numeral series—12,520 days—and counting from the first date—1 Ahau 13 Mac (9 Lamat)—we reach the latter date—2 Ahau 3 Uayeb—as, of course, we should. We thus have proof not only that Mr Goodman has correctly interpreted the symbol at D8 as that of the Uayeb, or 5 added-day period, but also additional evidence in favor of the number assigned by him to the face character of the first date. It may be said that this first date was found by counting backward from after dates. Be it so, this method is perfectly legitimate and is the only means of determination in such case unless his theory of counting from the beginning of the great cycle and also his interpretation of the face numerals be accepted. The symbols of the month and day of the month are clear, and limit the day to one of four—Ahau, Chicchan, Oc, Men—none of which, save Ahau, will connect with the following dates. I therefore deem the evidence sufficient for acceptance.

As 1 Ahau 13 Mac is reintroduced at D14, C15, it would seem that a new reckoning should begin from this point. The result of the trial, using the entire numeral series which comes immediately after the date is as follows:

	Days
7 cycles	1,008,000
7 katuns	50,400
7 ahaus	2,520
3 chuens	60
Days	16
Total	1,060,996
Deduct 55 calendar rounds	1,043,900
Remainder	17,096

As 1 Ahau 13 Mac falls in the year 9 Lamat, we reckon from that date, counting forward 17,096 days, and reach 2 Cib 14 Yax in the year 4 Akbal. This is correct except as to the month, which, as shown by glyph M1, is certainly Mol. It is evident, therefore, that Mr Goodman is wrong in assuming that the series 7–7–7–3–16 (or 17,096 days after casting out the calendar rounds) connects 1 Ahau 13 Mac of the left slab with 2 Cib 14 Mol, the first date of the right slab, unless the month is corrected to Yax. What he means by "40,000 days to be accounted for," and that they are to be accounted for by the reckoning "7–7–7–3–16 to 2 Cib 14 Mol," is not clear. According to his "synopsis showing the position of the dates in both [inscriptions]"

given above, the lapse of time, as can be seen by subtracting series 2 from series 10, is 52,520 days, thus:

Series 11..	9	12	18	5	16
Series 2...	1	18	5	4	0
	7	14	13	1	16
Fourth series left slab Foliated Cross	7	7	7	3	16
		7	5	16	0=52,520 days.

He makes the lapse of time from 1 Ahau 13 Mac to 2 Cib 14 Mol 7–14–13–1–16=1,113,516 days, or 12,676 after casting out the calendar rounds. That this number of days will connect the two dates is certainly true, but where is the evidence to justify this radical change of the numeral series by the addition of 52,520 days? Where is the proof that these two dates are to be connected by the fourth numeral series? A number can be found to connect any two dates, but there must be demonstration first that they are to be connected according to the plan of the aboriginal artist. The direct connection between the series of the left and right slabs is therefore not proved, though the reckonings given above seem to indicate it.

Passing over the middle space to the right slab, the first date (L1, M1), already noticed, is 2 Cib 14 Mol; the next, found at M5, L6, is 3 Caban 15 Mol, which is the next day in the calendar after 2 Cib 14 Mol, both being in the same year—5 Akbal. Following the latter at L16, M16 is what appears to be a numeral series (1), to wit, 6 ahaus, 9 chuens, 3 days. Whether this is to be recognized as a numeral series which is to be counted is uncertain, as it is immediately followed at M17, N1, O1, by the series (2) 4 days, 6 chuens, 9 ahaus, 2 katuns (17,764 days). The latter is followed at N5, O5 by a somewhat uncertain date, 8 Oc 3 Kayab, or 8 Ahau 13 Uo. The day is a face symbol and the month symbol is unusual, but more like that for Kayab than any other. It is included in Goodman's synopsis as 8 Oc 3 Kayab. This is followed at N6, O6 by the series (3) 6 days, 11 chuens, 6 ahaus (2,386 days), which, in turn, without any intermediate recognizable date, is followed at O13, N14 by the series (4) 4 days, 12 chuens, 1 ahau (604 days). This is followed at N15 by the date 8 Ahau 8 Uo. Immediately following, at O15, is the symbol for 13 katuns, which is followed by no date.

We find by trial that neither 2 Cib 14 Mol nor 3 Caban 15 Mol will connect by the first series, 6–9–3 (2,343 days), nor the second, 2–9–6–4 (17,764 days), with either of the dates which follow. The reckoning forward of 17,764 days from 2 Cib 14 Mol, year 5 Akbal, reaches 8 Ahau 13 Uo, year 2 Lamat, which might be accepted as correct, as the day symbol, which is a face character, is much like that for Ahau, but for three reasons: First, the month symbol is wholly different from that denoting Uo, though somewhat unusual, being apparently that for

Kayab; second, 8 Ahau 13 Uo will not connect with the following date; third, 8 Oc 3 Kayab will answer more requirements of the position than will 8 Ahau 13 Uo. Assuming 8 Ahau 13 Uo to be correct, the only connection is backward by the second numeral series, 17,764, with 2 Cib 14 Mol, first date of the right slab. Assuming the date to be 8 Oc 3 Kayab and counting forward 2,386 days, the third numeral series followed by no date, we reach 2 Cib 14 Mol, year 5 Akbal, which is presumed to fill the place of the missing date. Counting forward from this 604 days, the fourth numeral series, we reach 8 Ahau 8 Uo, year 7 Ben, the date which follows. I am inclined, though with considerable doubt, to accept this as the correct solution, as Goodman seems to have done, but it leaves us without any connection backward from 8 Oc 3 Kayab. Similar duplication of dates is found in the inscription of the Tablet of the Sun.

In this case, as well as in the preceding inscription, if we count 2,386 days (the number in the second series of the middle space in the Tablet of the Cross) from 8 Oc 3 Kayab in the middle space, we connect with 2 Cib 14 Mol, first date on the right slab.

Let us examine now Goodman's synopsis (page 766). By comparing it with the lists of the series of the Tablet of the Sun and the Tablet of the Foliated Cross (pages 761, 765), it will be seen that he begins with the first series on the left slab of the Tablet of the Sun (date 13 Cimi 19 Ceh). His next series is the first of the left slab of the Tablet of the Foliated Cross (date 1 Ahau 13 Mac) the lapse between the two being 14 days. His next (3) is the second series, left slab of the Tablet of the Foliated Cross (date 1 Cauac 7 Yax); his next (4) is the third, left slab of the Tablet of the Foliated Cross. This skips over the second series of the left slab of the Tablet of the Sun (date 2 Caban 10 Tzec). Moreover, the fourth series (4), which he gives here as 2–20–20–18–20 (the 20s and 18 each being in fact counted by him as 0, as can readily be shown by his own figures, 2–0–0–0–0 making the connection he designates), is made not by adding the third series of the left slab of the Tablet of the Foliated Cross (1–14–14–0) to his series 3, but to series 2, the second series of the tablet (14–19) being included, as I have shown, in the third (1–14–14–0). In other words, the count from 1 Cauac 7 Yax to 2 Ahau 3 Uayeb is to be obtained by subtracting series 2 (14–19) from the third series (1–14–14–0), left slab of the Tablet of the Foliated Cross. The next three dates, 12 Ahau 8 Ceh, 2 Cimi 19 Zotz, and 9 Akbal 6 Xul, appear to have been located by his theoretic scheme and not by the data obtained from the inscriptions. This may be shown as follows:

From 2 Ahau 3 Uayeb, third series of the left slab of the Tablet of the Foliated Cross, he skips to 12 Ahau 8 Ceh, first series on the right slab of the Tablet of the Sun, making a jump from the beginning of the second cycle (2–0–0–0–0) of his fifty-fourth great cycle to

9–3–1–15–0 (3 katuns, 1 ahau, and 15 chuens on the ninth cycle), and thence by the next step (6) to 9–10–2–6–6, 2 Cimi 19 Zotz, the date of the second series of the right slab of the Tablet of the Sun. This gives as the count forward from his date 4 to his date 5, 7–3–1–15–0, which, it is true, expresses the exact lapse of time between these two dates. But upon what evidence in the inscriptions is this succession founded? According to his own statement the lapse of time from 4 Ahau 8 Cumhu, beginning day of his fifty-fourth great cycle, to 2 Cib 14 Mol is 9–12–18–5–16, while in his synopsis the distance to 12 Ahau 8 Ceh is given as 9–3–1–15–0. It is apparent, therefore, that he places 12 Ahau 8 Ceh back, in the order of time, of 2 Cib 14 Mol, 9–16–8–16 or 70,676 days. As any given date will reappear in each calendar round or 52-year period, the position in the great cycle, even on his theory, should be determined by the series of the inscription. This is done in regard to 13 Cimi 19 Ceh, 1 Ahau 13 Mac, 1 Cauac 7 Yax, 2 Ahau 3 Uayeb, and also in regard to 2 Cib 14 Mol, but there is no evidence to show that it has been done in regard to 12 Ahau 8 Ceh, nor is any backward connection indicated by which the position of this date can be ascertained.

Starting with 12 Ahau 8 Ceh and the series (5) of his synopsis with which it is connected, as a basis, his count (6) to 2 Cimi 19 Zotz and thence (7) to 9 Akbal 6 Xul is in accordance with the numeral series, if we assume with him that the count from 2 Cimi 19 Zotz, second series, right slab of the Tablet of the Sun, though forward in the order of time, goes back in the arrangement of the inscription to the 9 Akbal 6 Xul which precedes it. But it is equally true that if, as he holds, the middle space follows the right slab, connection will be made with the 9 Akbal of the middle space. However, as the figures agree with the inscription, making the two minor changes in the numbers heretofore suggested, we pass to the following dates.

The connection of 9 Akbal 6 Xul with his date (8) 13 Ahau 18 Kankin is correct, the change heretofore suggested in the third numeral series, right slab, from 532 to 537, being made. But when we pass to his next series (9), date 8 Oc 3 Kayab, we find the interval 2–1–12–10 (15,010 days), which is evidently the date of the second series right slab of the Tablet of the Foliated Cross. This reckoning will, it is true, carry us back to 13 Ahau 18 Kankin, presumably the last date of the Tablet of the Sun, the same date appearing also in the middle space; but it is without any authority in the inscription. This is followed in his synopsis (10) by 2 Cib 14 Mol, which appears in the same relative position both on the Tablet of the Sun and the Tablet of the Foliated Cross, but refers here to the date to be supplied, as has been shown, to the third series on the right slab of the Tablet of the Foliated Cross. The interval he gives between the two dates is 6–11–6, which is in accordance with the inscription. This is followed (11) by 8 Ahau 8 Uo with an interval of 1–12–4, which is also correct.

It will be seen from this discussion that there are some breaks in his synopsis which will, until they are explained, leave it in an unsatisfactory condition. Nevertheless, as has been suggested, the two inscriptions appear to be based on the same general plan and intimately related; in fact, they present substantially the same chain of series.

TEMPLE OF INSCRIPTIONS

We turn next to the inscription found in the so-called Temple of Inscriptions, where we have the benefit of Mr Maudslay's photographs and drawings and, to some extent, of Mr Goodman's interpretation. As parts of the inscription have been badly defaced it is

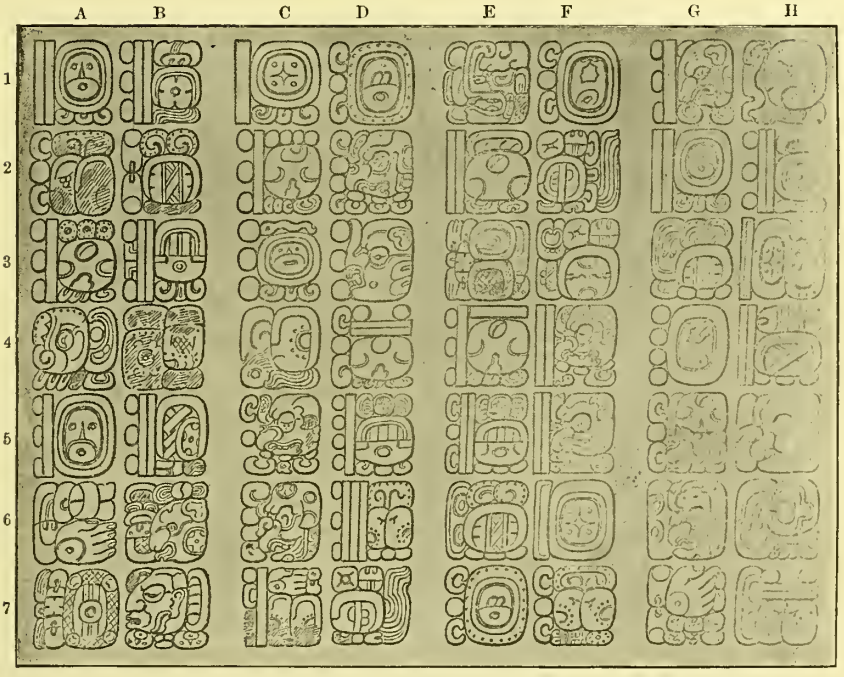


FIG. 18—Part of the inscription on the wall of the Temple of Inscriptions, Palenque.

impossible to give the series and dates in connected form. Attention will therefore be directed only to such portions as are sufficiently distinct to be determined with probable correctness by inspection. As Mr Goodman has given, on page 114 of his work, a copy of part of the inscription with comments, reference will be made first to this portion, of which a copy is given in our figure 18. This portion is lettered and numbered separately in the usual manner.

Mr Goodman's comments, as given on pages 114 and 115 of his work, are as follows, the breaks and parentheses being his own:

> The reading of the above, so far as I can make it out, is as follows: (To the) 10 Ahau . . . . . 13 Yaxkin . . . . . (that is) 1 calendar round . . . . . (from a, or the same) date appearing some distance back—8 days, 9 chuens (there is what

appears almost like a trick here: the number of chuens is not designated by three dots, but by three signs for 3) . . . . . (and) 12 ahaus . . . . . reckoning backwards, (by) katuns (probably a manner of denoting the reckoning to be a long one) . . . . . (to) 8 Ahau . . . . . 13 Pop . . . . . (1,040) bissextile periods (in addition. It is impossible, with our imperfect knowledge of the Maya numerals, to say just how this number of bissextile periods is expressed; but a subsequent reckoning shows that 80 calendar rounds, or 1,040 four-year periods, are implied here.) . . . . . reckoning backwards . . . . . (an unintelligible glyph; though, as is very like some we have just seen employed in scanning the katuns, it probably has the same significance as the katun sign previously made use of to indicate a long reckoning) . . . . . (to the) 5 Lamat . . . . . 1 Mol . . . . . (that is) 8 days, 4 chuens . . . . . (and) 2 ahaus . . . . . (from the) 3 Ahau, beginning a katun . . . . . 3 Zotz . . . . . a twentieth ahau (or beginning of a katun)—1 day, 12 chuens . . . . . 1 ahau . . . . . 9 katuns . . . . . (and) 2 cycles . . . . . (the count covering) 18 calendar rounds . . . . . (from, or to—for it is uncertain if the reckoning is intended to fix the position of the date 5 Lamat–1 Mol more circumstantially, or is a separate reckoning back from it) the tenth score (or fifth double score) of days, (in the) seventh cycle . . . . . (and) 7 days . . . . . (from the) twentieth (or beginning score) . . . . . 1 Manik . . . . . 10 Tzec (there is a mistake somewhere, as the date at that point is 9 Manik–20 Zotz) . . . . . the beginning of a seventh day (or 7-day period). Reckoning backwards, (by) katuns . . . . . (an unintelligible glyph, though it probably indicates a period of some kind) . . . . . 8 days, 5 chuens . . . . . 10 ahaus . . . . . 11 katuns . . . . . (and) 10 cycles . . . . . (to) a date appearing some distance back (8 Ahau–13 Pop: the reckoning here is an exact repetition, though in a different style, of the first of the preceding ones) . . . . . (from the) 5 Lamat . . . . . 1 Mol . . . . . (that is) 1 calendar round . . . . . (and) 8 days . . . . . (an unintelligible glyph) . . . . . (from the) 10 Ahau . . . . . 13 Yaxkin . . . . . appearing some distance back.—5 Lamat–1 Mol . . . . . 4 Manik . . . . . 10 Zip (I have no notion what these two isolated dates can mean, unless the former is a mere redundant repetition of the date from which all the reckonings have been made; but the latter has no apparent relation to anything else in the text).—1 cycle . . . . . 9 katuns . . . . . (and) 16 ahaus . . . . . (an unintelligible directive sign; the reckoning, however, is from 10 Ahau–13 Yaxkin, beginning the fouth ahau of the tenth katun of the tenth cycle—showing an abrupt and unaccountable leap forward) . . . . . (to the) twentieth (or beginning) score days . . . . . beginning the twelfth cycle.

The dates and numeral series in this portion of the inscription, taken in the order they come in the figure given above, are as follows:

							Days
						10 Ahau 13 Yaxkin (8 Lamat)	
1			12	9?	8	8 Ahau 13 Pop (9 Lamat)	4,508
						5 Lamat 1 Mol (8 Lamat)	
2			2	4	8	3 Ahau 3 Zotz (6 Ezenab)	808
3	2	9	1	12	1	1 Manik 10 Tzec (3 Ezenab) (353,401)	11,761
4	10	11	10	5	8	5 Lamat 1 Mol (8 Lamat) (1,522,908)	4,508
5					8	10 Ahau 13 Yaxkin (8 Lamat)	8
						5 Lamat 1 Mol (8 Lamat)	
						4 Manik 10 Zip (7 Ezenab)	
6	1	9?	16?	0	0	(no date) (214,560?)	5,780?

The first date (A1, B1) is 10 Ahau 13 Yaxkin; the next (A5, B5) is 8 Ahau 13 Pop. The glyph A2, which is one calendar round, is not included in the intermediate count. The intermediate numeral symbols (A3, B3) are 8 days, 3 or 9 chuens, 12 ahaus. Although there are only 3 dots or balls representing the chuens, they are, from their size

and certain marks on them, interpreted 3 times 3 by Goodman. The next date (A5, B5) is 8 Ahau 13 Pop, followed at C1. D1 by 5 Lamat 1 Mol without any intermediate numeral series. Following the latter date, at C2, D2, is the numeral series 8 days, 4 chuens, 2 ahaus (808 days). This is followed at C3, D3 by the date 3 Ahau 3 Zotz, and this, at D4 to C6 inclusive, by the numeral series 1 day, 12 chuens, 1 ahau, 9 katuns, 2 cycles (353,401 days). At D6 is the symbol for 18 calendar rounds, followed at E1, F1 by the date 1 Manik 10 Tzec; and this is followed, at E4 to F5 inclusive, by the numeral series 8 days, 5 chuens, 10 ahaus, 11 katuns, 10 cycles (1,522,908 days). At F6 E7 is the date 5 Lamat 1 Mol. This is followed immediately (F7) by the symbol for 1 calendar round, and this at G1 by the symbol for 8 days. Following this, at G2, H2, is the date 10 Ahau 13 Yaxkin; and this is followed (H3, in one symbol) by 5 Lamat 1 Mol, and the latter, at G4, H4, by 4 Manik 10 Zip.

Mr Goodman says the reckoning from the first date and generally in this inscription is backward, but it is certain that the count backward of 4,508 days (first series) from 10 Ahau 13 Yaxkin will not reach 8 Ahau 13 Pop, the next date, nor any following date given in the foregoing list. This first date (10 Ahau 13 Yaxkin) is probably connected with some preceding date not included in the portion of the inscription given by Mr Goodman which is now under consideration.

If we count forward 4,508 days from 8 Ahau 13 Pop, year 9 Lamat, the second date (first series of the list), we reach 5 Lamat 1 Mol, year 8 Lamat, the date next following. It is true that both dates come after the numeral series, but this occurs more than once in the inscriptions. If we subtract 808 days (the second series) from 4,508 (first series), the remainder is 3,700 days; counting forward this number of days from 8 Ahau 13 Pop, year 9 Lamat, we reach 3 Ahau 3 Zotz, year 6 Ezanab, the date of the second series. This, it will be remembered, is the rule which seems to prevail in two of the preceding inscriptions.

The next series (3), 11,761 days after the calendar rounds have been subtracted, is followed by the date 1 Manik 10 Tzec. This date Mr Goodman says is a mistake, "as the date at this point is 9 Manik 20 Zotz," which, according to the system I am using, would be 9 Manik 20 Zip. It is certain that 1 Manik 10 Tzec can not be connected by 11,761 days with any preceding or following date, whether the reckoning be forward or backward. If we adopt Mr Goodman's suggestion that the date should be 9 Manik 20 Zip (year 2 Lamat) and count forward 11,761 days, we reach 5 Lamat 1 Mol (year 8 Lamat), the date which follows. Although there is no second connection to confirm this suggestion, I am inclined to think it is probably correct. Counting forward 4,508 days (fourth series) from 8 Ahau 13 Pop, year 9 Lamat (first series), we reach 5 Lamat 1 Mol (year 8 Lamat), the date following the fourth numeral series; and counting eight days (fifth series)

from 10 Ahau 13 Yaxkin brings the reckoning to 5 Lamat 1 Mol, the next following date.

It appears, therefore, from these results that the reckoning so far is forward and not backward, as Mr Goodman maintains.

As the next numeral series (6 in the list given above) has the prefixed numerals, except the 1 (cycle), given in unusual symbols, and there is no recognizable date following within reasonable distance, we will turn to Mr Maudslay's photographs and drawings of the inscription, noticing such additional series only as offer sufficient recognizable data for examination. We take that following the portion which has been examined. This will be found in his photograph, plate 59, vol. IV, and drawing, plate 62, same volume. The numbering and lettering on his plate 62 will be followed. While I feel doubtful as to a number of the glyphs on the plate of drawings, judging by the nearly obliterated forms in the photograph, yet, as Maudslay had an opportunity of observing the original and of carefully studying the casts, I shall accept the drawings generally, expressing doubt where I deem it necessary.

Attention is called first to the somewhat doubtful glyph O7, denoting 7 Cimi 19 Ceh. Following this order, the reverse of the usual (P7 to P8), are the counters 9 cycles, 7 katuns, 11 ahaus, 3 chuens, 0 days (1,350,420 days); subtracting 71 calendar rounds—1,347,580 days—leaves 2,840 days to be counted. As the counters are reversed in order, our count will be backward from 7 Cimi 19 Ceh, year 3 Lamat. This we find will reach 1 Cimi 19 Pax in the year 8 Lamat, the next date, found at O10, P10. As the agreement with the inscription is exact, the count appears to be correct. The cycle and ahau symbols here are face glyphs.

The series commencing with the date 7 Caban 15 Pop (Q6, R6) has as its counters 1 day, 6 chuens, 7 ahaus, 2 katuns (Q7 to Q8), equal to 17,041 days. As 7 Caban 15 Pop falls in the year 6 Akbal, counting forward this number of days we reach 5 Ezanab, the 6th day of Kankin in the year 13 Ben. This agrees exactly with the inscription, as we find 5 Ezanab 6 Kankin farther on at Q11, and the counting in this case is forward, as has been found to be the rule of this inscription with the one exception noted. Counting forward from the last date—5 Ezanab 6 Kankin—2 days 11 chuens (R11) and 9 ahaus (Q12), or 3,462 days, we reach 9 Ahau, the 18th day of the month Zotz in the year 10 Akbal. This is correct, as the latter date is found in the double glyph S1. The last chuen symbol (R11) is a face glyph.

As these are the only series of this inscription presenting data sufficient for satisfactory computation, I will notice one or two glyphs and pass to other inscriptions. At L8 and P5 are ahau symbols, which appear to take the place of katun symbols, but I am unable to prove this by count. In the latter instance there is a date immediately pre-

ceding and dates following, but I am unable to make connections by including or excluding the above symbol, either by counting backward or forward, though the date which follows is clearly determined by a computation, given above.

Tikal Inscriptions

Our next examples will be from the Tikal inscriptions, but here we will use Rosny's photograph of the so-called "Bas-Relief de Bernoulli" (Les Docs., Ecrits de L'Antiq. Americain, Mem. Soc. Ethn. vol. I, 1881), Maudslay's figures not being at hand. Rosny's plates 10–11 represent a standing individual literally overwhelmed with ornaments and overarched by a great serpent, from whose wide-open jaws protrude the head, shoulders, and arms of a human form. In the upper left-hand and right-hand corners are the inscriptions, each of four columns. The carving in this case is on wood. The inscription in the upper left-hand corner is shown in part in our figure 19.

The first two glyphs (A1, B1) represent the date 3 Ahau 3 Mol, which falls in the year 4 Ezanab. At B3, A4 is the next date, 11 Ik, and apparently 15 Chen. The number symbols between these are (B2), 2 days, 2 chuens, and (A3), 2 ahaus, together equal to 762 days. Counting forward 762 days from the first date (3 Ahau 3 Mol), we reach 11 Ik 15 Chen in the year 6 Lamat, which is correct.

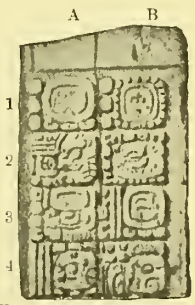


Fig. 19—Part of the inscription at Tikal.

The inscription on plate 12, same work, commences, like the first, with 3 Ahau 3 Mol, but the numbers are too much injured, until the lower half is reached, to trace the series correctly. The seventh glyph in the right column and eighth in the left give the date 7 Ben 1 Pop. Near the bottom are two numeral symbols giving 7 days, 2 chuens and 3 ahaus, equal to 1,127 days, followed by a date 3 Ahau 13 — ? the month date being nearly obliterated. Counting forward from 7 Ben 1 Pop in the year 7 Ben 1,127 days, we reach 3 Ahau the 13th day of the month Uo in the year 10 Lamat. This is correct, as the portion of the month symbol remaining is not inconsistent with the Uo symbol in the Dresden codex.

It is noticeable that all the chuen symbols in these two inscriptions are face forms, the ahau symbols ordinary and face forms. It may also be remarked in passing that the glyphs in these inscriptions are the most delicately and tastefully ornamented of any which have so far been found in Central America or Mexico.

On plate 13, same work, is a brief inscription from the same bas-relief. The first date is — ? Ahau 13 Pop, the number to the left of Ahau being defaced. Following these are the numerals 18 days, 7 chuens, equal to 158 days, and the date 11 Ezanab 11 — ? the month

symbol indicating Chen or Muan, apparently the former. If we assume the day of the first date to be 4 Ahau, the count is correct and the latter date is 11 Ezanab 11 Chen.

Copan Inscriptions

We turn now to Maudslay's photographs of the Copan inscriptions, commencing with that on Stela A, according to the method adopted by this explorer of designating the monoliths of this locality. As Mr Goodman refers to the inscriptions of this place, we will notice his comments so far as is deemed necessary.

STELA A

The great cycle which Mr Goodman numbers 54 being omitted, the remainder of the initial series in which the attached numerals are of the usual form—dots and lines—is as follows: 9 cycles, 14 katuns, 19 ahaus, 8 chuens, 0 days, to 12 Ahau 18 Cumhu. The symbol here interpreted Ahau is an unusual, inclosed face glyph. The two parts of the date are some distance apart, the Ahau at B3 and the Cumhu at B8. After passing over several glyphs, we reach at C15 the symbol for 3 chuens, 0 days, and passing over twelve pair of glyphs reach 4 Ahau 18 Muan. According to Mr Goodman, the first date is to be connected with the second by counting backward. Counting back 3 chuens or 60 days from 12 Ahau 18 Cumhu will bring us to 4 Ahau 18 Muan, but this omits from consideration a number of intermediate glyphs with attached numerals. If the reckoning be correct, it will prove that the face glyph at B3 is Ahau.

STELA B

The initial series on Stela B, like the preceding one, has ordinary numerals prefixed to the time period or order-of-units symbols, though the latter are face characters. This series is 54–9–15–0–0–0, or fifty-fourth great cycle (Goodman's numbering), 9 cycles, 15 katuns, 0 ahaus, 0 chuens, 0 days, to 4 Ahau 13 Yax. According to Goodman's interpretation as applied to his scheme of the Mayan time system, the terminal date of the initial series of this inscription should be precisely 10 chuens or 200 days later in time than the terminal date of the initial series on Stela A; this, however, as will be shown farther on, does not prove to be so.

STELA C

As there are no other recognizable series on Stela B, we pass to Stela C. In regard to this inscription Mr Goodman appears to be in much doubt. His remarks are as follows:

> Nearly everything about this inscription appears to be wrong. The principal reckoning does not accord with the dates given. The initial date to the left is 6

Ahau 18 Kayab, designated by the first glyph to be a certain number of score days in a 13th cycle. As all the dates are indicated to be the beginning of ahaus, this particular date must be in the 13th cycle of the 55th great cycle, as no ahau in the 13th cycle of the 54th great cycle begins with 6 Ahau 18 Kayab. In the 55th great cycle it is 13–2–18–18×20. From this date, according to the glyphs as drawn, there is a reckoning of 11–14–5–18×1 to either another 6 Ahau 18 Kayab or to an 8 Ahau 13 Muan; but such a reckoning would reach neither of those dates—both of which are designated as beginning an ahau—even if there were no odd day or chuen. The only explanation I can conceive is that the reckoning is, or was intended to be, 11–17–5–18×20, which is 5 ahau rounds; and as the same ahau date recurs at each round, the 6 Ahau 18 Kayab would be correct in that event. But this would leave the next date, 8 Ahau 13 Muan, still a mystery, it appearing to have no connection with the preceding dates. As the beginning of an ahau it could not occur anywhere in the vicinity except at 54–12–16–1–18×20. The second section, like the first, begins with a glyph indicating the date to be certain scores of days in the 13th cycle. The day number is given as 15, but of course that is impossible. From a later examination of the stone Maudsley thinks it may be 9 or 5. It is probably the former, the date in all likelihood being—55–13–2–14–18×20—9 Ahau 18 Cumhu. In this event, the character under the ordinary numeral accompanying the month symbol must represent 10. The rest of the inscription is unintelligible, except the two dates, 4 Ahau 18 Uo and 5 Ahau 8 Uo.

Unfortunately Maudslay's photographs of the inscriptions on this stela are not sufficiently distinct and clear to enable us to thoroughly test his drawings by inspection, and the latter are not entirely satisfactory.

The initial series in this instance appears to consist of the single symbol denoting 13 cycles, followed immediately by 6 Ahau 18 Kayab. This, written out after the method adopted, would be 54–13–0–0–0–0, to 6 Ahau 18 Kayab, or fifty-fourth great cycle, 13 cycles, 0 katuns, 0 ahaus, 0 chuens, 0 days, to 6 Ahau 18 Kayab, assuming the date to be in Goodman's supposed fifty-fourth great cycle. However, according to this author, no ahau in his fifty-fourth great cycle begins with 6 Ahau 18 Kayab, but, as he finds by reference to his scheme as shown in his tables, that it does begin the eighteenth ahau (according to his method of counting) of the second katun of the thirteenth cycle of the fifty-fifth great cycle, he places it there. It is apparent from this fact that he has determined the number of the great cycle not by an inspection of the initial or great cycle glyph, but from his system. Has his determination of the numbers of the other two great cycles he mentions been reached in the same way? I am strongly inclined to think that it has, as the process to be followed in determining the numbers from the details of the initial glyphs is not clearly given nor fully explained anywhere in his work.

There is an initial series to another inscription on this stela, but it is unintelligible to me and apparently so to Goodman. There is one numeral series in the first inscription, but it will not connect dates.

STELA D

The inscription on Stela D presents the unusual feature of giving the symbols in the form of the entire body of the person or animal, instead of simply the head, of which a parallel, so far as I am aware, is found only in some of the Mexican codices. No series except the initial one is recognizable. Some aid, however, may be obtained from this singular inscription in determining the signification of the time and numeral symbols. For example, the cycle and katun symbols have each, as an essential portion of the glyph, a bird form in connection with the human figure; the ahau has a nondescript monster; the chuen, what I take to be a frog, and the symbol for the month Zotz (if Mr Goodman be correct in his determination), the figure of a leaf-nosed bat. The grand cycle, or initial glyph, has as the sidepiece (each side) a fish. I am inclined to believe that these figures, which (with the exception of the bat) appear to be unessential for the determination of the time periods or orders of units, are used as symbolic of the names assigned to these periods.

The initial series in this case, as determined by Mr Goodman, is 54–9–5–5–0–0 to 4 Ahau 13 Zotz.

STELÆ E AND F

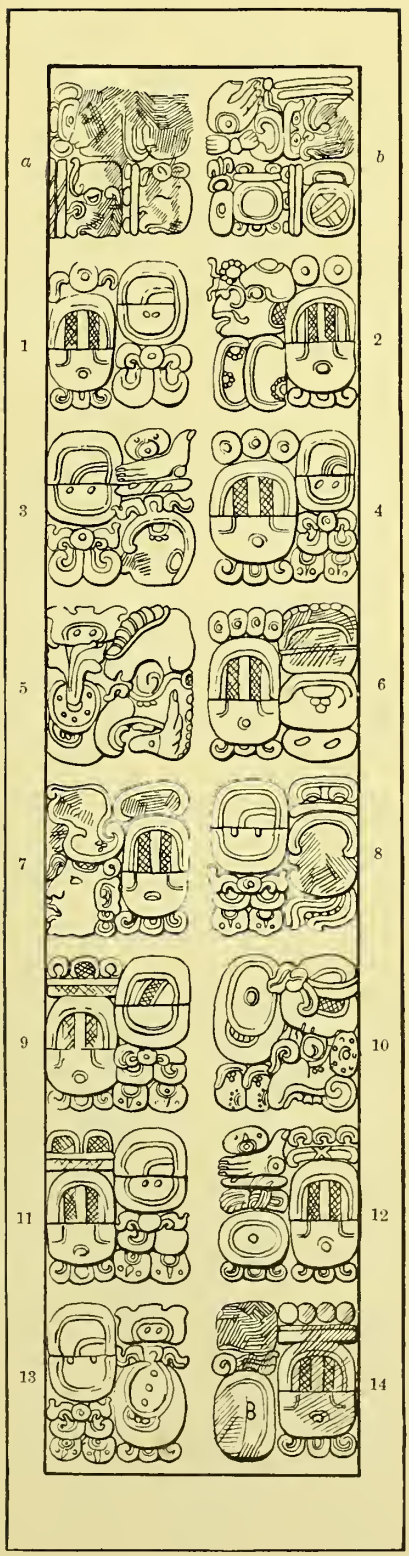
Stela E presents no recognizable initial or other series or determinable dates. The same may be said of Stela F, though Mr Goodman gives an initial series which is confessedly presented "irrespective of the reading of the inscription."

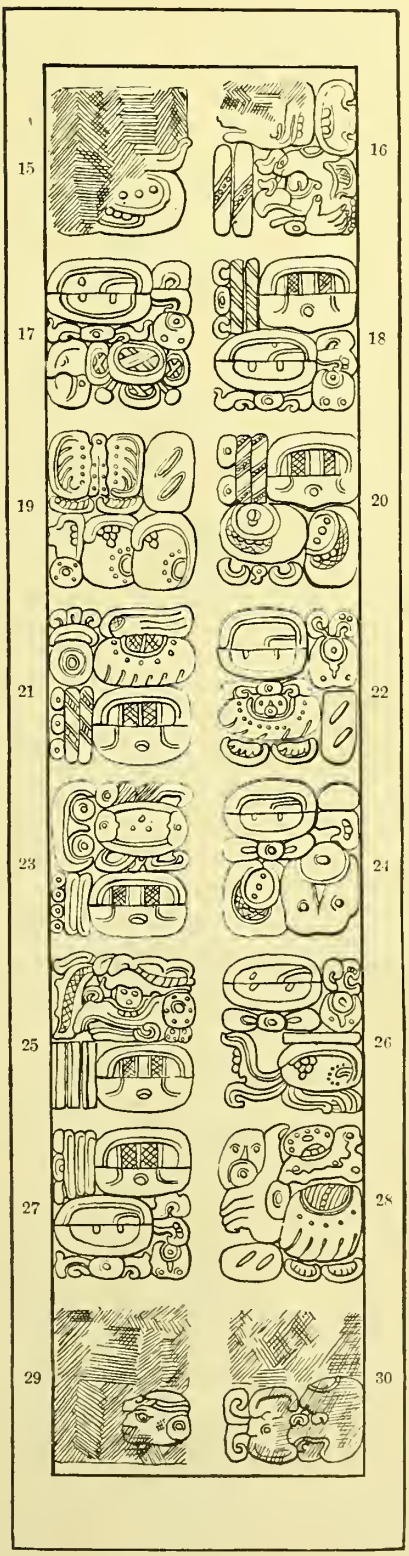
STELÆ H AND I

Passing over Stela H, whose inscriptions present no connected dates, we come to that on Stela I. Fortunately we have good photographs by Maudslay of the inscriptions on this Stela. The initial series as given by Mr Goodman is 54th great cycle, 9 cycles, 12 katuns, 3 ahaus, 14 chuens, 0 days—5 Ahau—"the month date should be 8 Uo, but the glyph which here follows after the initial directive series is obliterated." The ahau symbol is here the figure of a bird's head, and the number a symbol. The month symbol, which Mr Goodman says is obliterated, is, on the contrary, quite distinct, the only injury being a slight break in the attached numeral, which appears to be 8. The month symbol is apparently that of Chen; if of Uo, it is a quite unusual form. However, as this does not connect with any other date, we turn to the inscription on the north side.

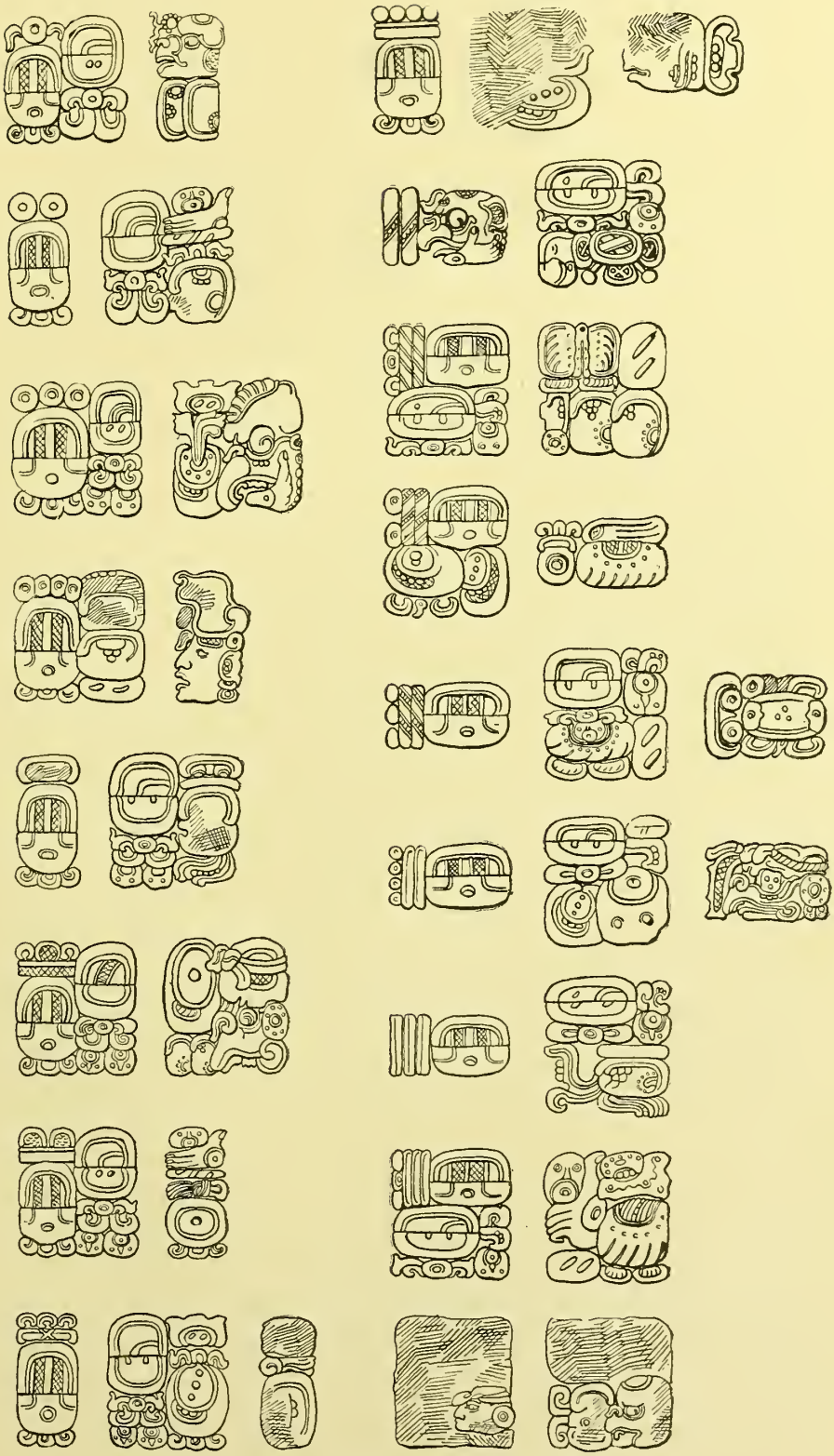
Mr Goodman's statement in regard to this inscription is as follows:

> There 10 Ahau 13 Chen is designated as the beginning of a katun—an 8th katun as given * * * There follows a reckoning of 8 days and 10 chuens from 10 Ahau 13 Chen to 10 Lamat—the month date not given, but we know it must be 16 Pop.





INSCRIPTION ON STELA J, COPAN



GLYPHS FROM STELA J, COPAN

Maudslay's photograph of this third row as published in his plate 65 is, so far as the first group, which includes the date mentioned, is concerned, too dim and imperfect to determine the glyphs with even a reasonable degree of certainty, but as Mr Goodman had original photographs, and Maudslay's drawings are more complete, the original inscription may have been clearer than the published photograph (autotype). From the drawing, the Ahau symbol is seen to be of the usual form, but the attached numeral, if it be such, is a face character similar to the second form of 10 given by Mr Goodman. The number 13 over the month symbol is of the usual form (balls or dots and lines); the month symbol is incomplete, but the remaining portion, as given in the drawing, with the exception of the cap piece, which is like that of Chen, is more like Yax, Zac, or Ceh. The symbol for 8 days in the reckoning is separate from the chuen symbol. The number over the chuen is a face form, the same as that noticed above as 10. The 10 Lamat which follows is distinct and of the usual form. It is followed immediately by a glyph with the usual numeral symbol for 9 attached. Although Mr Goodman says "month date not given," this glyph resembles almost exactly that in the inscription on the back, which he calls Uo, but which is more like Chen. The only objection to assuming it to be a month symbol is that Lamat is never the 9th day of the month, but similar errors in this respect have been observed. It is true that if we count 8 days, 10 chuens (=208 days) from 10 Ahau 13 Chen, we will reach 10 Lamat 16 Pop of the following year; but the test is never satisfactory without the month and day of the month, except in case of continued series, as in the codex, where the error, if one is made, can be corrected by the preceding or following differences. Let us in this case change the number attached to the glyph following 10 Lamat to 11, and call the month Chen, which it most resembles. Counting back we vary but one day from 10 Ahau, but the month will be Kayab. This series is therefore not sufficiently certain to decide positively that Mr Goodman's assignment of the number 10 to the face glyph over the Ahau symbol is correct, but we are justified in accepting this face character as a numeral, as characters denoting 0 or 20 are never attached to symbols representing particular days.

STELA J

One of the most important inscriptions at Copan is that on the north and south faces of Stela J, the two sides forming one series. This is shown in plates XLIII*a* and XLIII*b*, which are as nearly as possible copies of Maudslay's drawings, these being selected rather than the autotype, which in some places is a little dim. As the glyphs are all numbered except the upper two on the north side, marked A and B, they will be cited by the numbers.

A slight glance over the inscription is sufficient to call attention to

the frequent repetition of the so-called ahau time or numeral symbol. By beginning with glyph 1 and following down the first two columns and then down the second two as numbered, it will be seen that they have numerals attached, beginning with 1 and proceeding in regular order, 2, 3, etc, up to 16. The remaining numbers, 17–20, do not appear to have been given on the Stela.

As Mr Goodman's comment on this inscription reveals his method of ascertaining numeral characters, it probably will be best to give it in full:

FIRST AHAU—360 DAYS

Second glyph—The upper character is one meaning beginning, or from the beginning, as we have learned from its use elsewhere with directive and period signs, so there will be no necessity for speaking of it again. The inference is plain that the characters under it represent the number of days in the single ahau that has passed. They consist of a composite sign surmounting two opposed coils—the coil, however, not being as plain in this particular instance as in succeeding ones. We have long suspected all forms of the coil, where it went beyond a mere curve, to be indicative of 9, and the subfix of the ahau symbol has pretty well satisfied us of it. Now, these are identical with the coils in that subfix, but they have not the centerpiece between them which there multiplies them by 4. Hence, these must stand for 18 simply, one of the commonest constituents of 360, the ahau number of days. In that case the other factor must be 20, represented by the composite character above.

Third glyph—Here we recognize the double *cauac* character, which we know stands for 20 days, from its employment in the symbols for the calendar round and cycle. It follows that the head above it must imply 18, but unfortunately it is too mutilated to clearly make out if it has the characteristics of the ordinary 18 face or is a variant.

SECOND AHAU—720 DAYS

Second glyph—The same two coils; hence the composite character above them here must denote 40.

Third glyph—The 10-day sign qualified by three characters that should aggregate 72. We should not be able to make them out but for knowledge subsequently gained. If you will look down to the seventh ahau you will see, in the second glyph, the under one of these three characters. Its position there proves it to be 35. The middle numeral is a bar with a band crossing it obliquely in the center—a sign for 9; but here there are two other partial bands, so that presumably it is three times nine, or 27. We are yet ten short of the necessary total. In the top sign, we know the *ahau* stands for 4, the hand ordinarily for 5; but as the upright thumb by itself means 1, the hand in this position evidently has the value of 6.

THIRD AHAU—1080 DAYS

Second glyph—One of the coils disappears here and a sign for 3 takes its place. As the 9 element, which is an indispensable constituent of the ahau total, would be lost by addition, this 3 must serve as a multiplier—$9\times3=27\times20=540\times2=1,080$. The multiplication also shows us that the duplicate character at the bottom has here but a single value.

Third glyph—The *yax* character which in the month symbol has the value of 4, an outflaring sign which in another inscription distinguishes a fifteenth katun, and a character that must signify 18, to make up the complement of days—$15\times4=60\times18=1080$.

Fourth glyph—We must infer this to be an arbitrary sign, equivalent to a third ahau, or three ahaus.

Fourth Ahau—1440 Days

It will be observed that the reckoning of the days is missing here—a fact that will become important when we reach the next ahau.

Second glyph—As a portion of this is obliterated we will pass it by. It is a waste of time to study illegible glyphs when the missing part is not restorable from what is left or from the context.

Third glyph—Same remarks.

Fifth Ahau—1800 Days

Second glyph—18×40=720×2=1,440; hence this glyph should have gone with the preceding ahau.

Third glyph—A symbol which appropriately denotes the beginning of a fifth ahau in several other places in the inscriptions. I call attention to the peculiar character of the wing, or whatever it may be termed. It is not the ordinary form, signifying 20, but must have the value of 36—10×5=50×36=1800.

Sixth Ahau—2160 Days

Second glyph—The under number being 4 here, the character above the coils should represent 30, but instead it represents only 25—18×25=450×4=1800; hence this glyph should have gone with the fifth ahau.

Third glyph—The 20-day sign again, qualified by a character which the connection requires to be a sign for 108—108×20=2160.

Fourth glyph—An arbitrary sign, probably, for 6 ahaus or a sixth ahau.

Seventh Ahau—2520 Days

Second glyph—18×4=72×35=2520.

Third glyph—Two of the characters encountered above reappear here, associated with a knot which we know to be a sign for 5 or some of its multiples. As neither 10, 15, nor 20 added to the other characters would form a number that would be an even divisor of 2,520, we must consider this a sign for 5 and the character underneath it to represent 60—10+27+5=42×60=2520. The subfix here, consequently, notwithstanding its resemblance to the character representing 72, can have no value, but must serve merely as a pedestal, as it does under the day symbols.

Eighth Ahau—2880 Days

Second glyph—18×40=720×4=2880.

Third glyph—18×40=720×4=2880. The subfix is without value here also.

Fourth glyph—Too defaced to justify any estimate of it.

Ninth Ahau—3240 Days

The computation, if there was one, and the equivalents are defaced beyond the possibility of recognition.

Tenth Ahau—3600 Days

The ahau sign here differs from all the rest. It is the symbol used in a Tikal tablet to denote a date to be a tenth ahau.

Second glyph—The two coils do not appear here, only one; but that one is qualified by a curve, signifying 5. As it can not be added without destroying the 9 element, it must serve as a multiplier—9×5=45×40=1800×2=3600. The 2 sign here looks something like the *ahau* character for 4, but the context requires it to be 2.

Third glyph—The symbol that everywhere denotes a tenth ahau or an even 10-ahau reckoning, with the character that commonly constitutes its center placed beside it.

ELEVENTH AHAU—3960 DAYS

Second glyph—The stone is so badly mutilated that this glyph can not be restored with certainty. If the characters that are tolerably preserved be 5, 9, and 2, the other should be 44, but I distrust their identity.

Third glyph—There may be two glyphs here, though I think not. The 20-day period being the factor to be raised, it requires 198 for a multiplier to bring it to the necessary total. The character to the left of it being 1, there is good reason for supposing it to represent 73, and the right-hand sign at the top being 18, it follows that there can be no multiplication of these numerals, but that they must be added; hence the remaining characters must aggregate 107. The comb sign—though duplicated here, as in many other places, to give it a more ornamental effect—probably represents but 20. That leaves 87 to be accounted for by the remaining character. It is a sign that occurs many times, but its central part is seldom twice alike, sometimes being a single bar, sometimes two, and again something quite different. Here it has the appearance of the spire in the *akbal* sign, which stands for 7. On either side is a comb sign for 20, raised to twice that value by a line of dots. It is possible, therefore, that the two together may represent 80, the particular center part in this instance raising the full value of the character to 87.

TWELFTH AHAU—4320 DAYS

Second glyph—At first view the principal factors appear to be identical with the characters representing 108 and 18. But the ball in the center of the first is double, and there is cross hatching on both, which may modify the meaning. The character at the bottom seems to be only a beginning sign, though its form is somewhat unusual. If the right-hand sign be 18 and the subfix nothing, the other character must represent 240; but there is too much uncertainty involved to warrant confidence in this deduction.

Third glyph—Here again we are nonplussed. We know the bouquet sign for 6 (the same as that over the symbol for Zac) and the *ymix* character for 5; but the latter has a peculiar marking at the top, and we do not know how that may alter its value. The character over it may be a multiple of 20, as it has the general appearance of the wing sign for that number with a qualifying mark at the left part of it. For a reason that will be made evident later on, we will assume that it represents 120, and the *ymix* character 6—$120 \times 6 = 720 \times 6 = 4320$.

THIRTEENTH AHAU—4680 DAYS

Second glyph—Here the signs for 9, 5 and 4 are plain, indicating that the other character must be 26—$9 \times 5 = 45 \times 4 = 180 \times 26 = 4680$.

Third glyph—The chief factor here is a 260-day sign which we encounter elsewhere. It consists of the *ahau* sign, doubled in value by the surrounding row of dots, and inclosed in the *ymix* character for 5—$4 \times 2 = 8 + 5 = 13$, and then multiplied by 20, denoted by the duplicate comb sign below—$13 \times 20 = 260$. There are just eighteen of these periods in 13 ahaus; hence the character to the right must represent 18.

Fourth glyph—A beginning sign before a glyph that must necessarily be a symbol for a thirteenth ahau or 13 ahaus.

FOURTEENTH AHAU—5040 DAYS

Second glyph—There is doubt if this was intended for a single glyph, or if two glyphs were artfully or accidentally mixed up. The characters, moreover, being so nearly illegible that there is no certainty about them, it would be useless to attempt a solution of the puzzle.

Third glyph—A head that appears to be a compound of the chuen and ahau heads. As it probably represents an ahau, the sign in front of it must stand for 14.

FIFTEENTH AHAU—5400 DAYS

Second glyph—The 9, 5, and 4 signs are plain here; the other character, therefore, must be 30.

Third glyph—The 5-ahau character, qualified by a sign that must represent 3—the whole being a symbol for a fifteenth ahau, or 15 ahaus.

SIXTEENTH AHAU—5760 DAYS

Second glyph—A different character qualifies the coil here. It must stand for $4\text{–}9\times4=36\times4=144\times40=5760$.

Third glyph—The same form of the *ymix* character encountered at the twelfth ahau is again the central figure, but here it has a 20 sign under it, which presumably raises it to 120. If so, it requires to be multiplied by 48 to make up the total number of days. The signs for 18 and 10 leave 20 to be supplied by the other character, which is the skeleton jaw, an invariable sign for 10, here doubled in value by the row of dots in the upper part.

The manner of piecing out the numerals in some of the above instances has been too forced for the result to be regarded as altogether trustworthy. There are also several inconsistencies or errors; but, take it all in all, the number of occurrences in perfect accord with our assumption is too great to be attributable to accident, and we are therefore justified in believing our theory to be correct, however we may have erred in particular applications of it. We have gained a great deal more than is apparent at a first glance. Not only have a considerable number of equivalents for different ahaus and symbols for minor time periods been identified and the value of many new numeral signs established, but—more important than all this—we have satisfied ourselves that there is a plan underlying the employment of a portion of these signs which is capable of almost unlimited variation and extension.

As our investigations so far appear to confirm sufficiently for general acceptance Mr Goodman's interpretation of the symbols denoting the orders of units, or time periods as he terms them, we may now inquire how far the data bear out his announcement of various other numeral symbols. That there appears to be sufficient basis for his idea that certain face characters are used as numerals has already been noticed, though the evidence is as yet not entirely satisfactory as to the values assigned some of them. In his comment on the inscription now under consideration he goes more into detail in this direction, assigning number values to the component parts of and appendages to glyphs. In our examination of this inscription we shall notice briefly some of these ideas as we proceed.

In the paragraph immediately preceding the long quotation given above he remarks as follows:

> We start with the assumption that every glyph following a particular ahau represents it or its value in another way. The fact that there is no twentieth ahau—which, so far as the symbol that numeral is attached to is concerned, means no ahau at all—shows that one full ahau, or 360 days, is considered to have passed when the table begins.

Here, at the outset, we are met with an assumption which seems to cover half the ground to be examined. On what grounds does he base the opinion that "every glyph following a particular ahau represents

it or its value in another way?" This, in the absence of proof, is but simple guesswork. However, before we examine it, attention is called to the further assumption that what would, according to his system, be the beginning ahau of the series, which he would number 20, is omitted because it is considered as already passed. He observes in a quotation which will be found on a previous page of this paper, that ahaus are numbered 20, 1, 2, 3, etc., up to 19, but the evidence to establish the correctness of this assertion is nowhere given in his paper. I presume, therefore, that it is based upon the chronologic system that he has constructed, of which further notice will be taken before closing this paper. But how does it happen they are found numbered 1, 2, 3, etc., in an inscription when Mr Goodman tells us that in the katuns, taken in their order, they were numbered 9, 5, 1, 10, 6, 2, 11, 7, 3, 12, 8, 4, 13? That, in telling in a numeral series how many ahaus are to be added, the numbers must be given 1, 2, 3, etc, is very evident; but if ahaus were real periods in the Maya chronology, and not simply units of the third order, as we have stated, why are they not numbered in this inscription in the order in which they come in the katun? It may readily be seen that the succession 9, 5, 1, 10, 6, etc., arose from counting by the day numbers 1–13 by divisions of four, as in the series in the Cortesian codex, the count being backward; as, for example, counting upward from the bottom of one of the other columns in table 3, or by the 360-day periods, as referred to elsewhere and as asserted by Mr Goodman.

He quotes the following from Perez (page 12):

> There was another number which they called *ua katun*, and which served them as a key to find the katuns. According to the order of its march it falls on the days of the *uayeb yaab* and revolves to the end of certain years: katuns 13, 9, 5, 1, 10, 6, 2, 11, 7, 3, 12, 8, 4.

On this he remarks as follows (loc. cit.):

> Poor Don Pio! To have the pearl in his grasp and be unaware of its priceless-ness—like so many others! But I must not exult too much yet. The succession of the katuns, reckoned according to this principle, is yet to be ascertained before my fancied discovery can be established by a crucial test. I score the ahaus off in the foregoing order, and, sure enough, the twentieths give the desired result: 11, 9, 7, 5, 3, 1, 12, 10, 8, 6, 4, 2, 13. Eureka! The perturbed spirit of the Maya calendar, which has endeavored so long to impart its message to the world, may rest at last.

As the "uayeb haab" signifies the five added days of the year and is so recognized by him, how is it possible to reconcile this count, which "falls on the days of the uayeb haab," with the count of his ahaus which only cover 360 days each and recognize no 5 added days, which only come into notice when the year of 365 days is considered, which he says the Maya left behind when they entered on a chronologic count? It seems doubtful, therefore, whether this explanation will allay "the perturbed spirit of the Maya calendar."

By reference to his comment on the ahaus of this inscription, as quoted above, it will be seen that he uses the coils and other parts of the attached and accompanying glyphs as multipliers, assigning values to them that bring out the desired number. It is unnecessary to follow his process, as it is given fully in the quotation. But all this is presented without proof that the values assigned are correct, or, in fact, that the characters are number symbols. Until evidence rendering such interpretation at least probable is presented, it is nothing more than a guess. However, it must not be taken for granted that I reject all these symbols and appendages as not indicating numbers, as two or three already noticed (besides face characters) appear from satisfactory evidence to have been used as numerals; and it will be seen farther on that there are reasons for believing there are some appendages which are also thus used. The point made above is that Mr Goodman fails to present reasons for his assertions in this respect, which necessitates going over the entire record to verify or disprove them.

That the symbols in this inscription which Mr Goodman designates by the name "ahau" are to be counted as equivalent to 360 days each must be admitted, but the name ahau, it must be remembered, is, as applied here, merely an arbitrary designation, and its use is wholly different from that made of it by the natives, so far as the preserved records show.

ALTAR K

The inscription on Altar K contains nothing recognizable save a portion of the initial series which is given by Mr Goodman as follows: 54–9–12–16–7–8—3 Lamat 16 Yax, or fifty-fourth great cycle, 9 cycles, 12 katuns, 16 ahaus, 7 chuens, 8 days. As no photograph is given by Maudslay, we have no means of testing his drawing (plate 73, part 3). The prefixed numerals in this case are the usual dots or balls and short lines, but are not sufficiently distinct to verify Goodman's interpretation; in fact, the number prefixed to the chuen symbol looks more like 10 than 7—is 10 if Maudslay's drawing be accepted—and the day glyph is wholly obliterated. The series and date as given by him are therefore largely conjectural, the latter having evidently been obtained by calculation according to his system, and not from an inspection of the inscription.

STELA M

The initial series on Stela M, as given by Goodman, is 54–9–16–5–18–20—8 Ahau 8 Zotz, or, changing the 18 and 20 to 0, as we have found to be correct, the fifty-fourth great cycle, 9 cycles, 16 katuns, 5 ahaus, 0 chuens, 0 days, to 8 Ahau 8 Zotz. The prefixed numerals in this series are of the usual form, balls and short lines, and agree with Goodman's interpretation.

STELA N

Of the inscriptions on Stela N, Maudslay gives both photographs and drawings, the former somewhat indistinct, but the latter very clear. The initial series on the east side as given by Mr Goodman is as follows: 54–9–16–10–18–20—1 Ahau 8 Zip, or as we write it, fifty-fourth great cycle, 9 cycles, 16 katuns, 10 ahaus, 0 chuens, 0 days to 1 Ahau 8 Zip. This is correct, if the month symbol, which is inverted and stands at some distance from the day glyph, has been correctly interpreted, sa the prefixed numerals are of the ordinary form and distinct. Mr Goodman says "the month symbol is wrong; it should be 3 Zip." This is true if we accept his theory that the count is to be from 4 Ahau 8 Cumhu, the assumed initial date of his fifty-fourth great cycle.

As an important question arises in regard to the series on the west side of this Stela, we quote the following from Mr Goodman in regard to it:

> At the top of the second column occurs the sign that indicates a reckoning backward. It is followed by seven glyphs, which I think give in another form the substance of the subsequent reckoning, which is the longest that occurs in any of the inscriptions, embracing a period of 75,264 years. It is given as 14–17–19–10–18×20 from the initial date to 1 Ahau 8 Chen, the beginning of a katun, etc. The reckoning is not only wrong, but is absurd as well. The cycles run only to 13, and no such reckoning backward or forward from the initial date would reach a 1 Ahau 8 Chen. But fortunately, despite all the blundering, we can see what the intention was. 1 Ahau 8 Chen begins the 17th katun of the 8th cycle, and thence to the initial date is just 19 katuns and 10 ahaus. The fact that these are the numbers of katuns and ahaus expressed in the reckoning would lead us to suspect that it was to go backward even if the directive sign had not already so informed us, for that would do away with the odd katuns and ahaus and leave the reckoning in even katun rounds. If it were to have gone forward, the odd numbers would have been 3 great cycles, 7 cycles, 9 katuns, and 10 ahaus. A little figuring will show the difference. . . . It will be borne in mind that 3 great cycles, 8 cycles, and 9 katuns are the equivalent of a katun round—that is, the time that must pass between two occurrences of any given date as the beginning of a katun.
>
> In thinking of the odd 19 katuns and 10 ahaus, they blundered in respect to the total period. I think it should be 14–8–15–10–18×20. If so, the reckoning goes back to the 40th great cycle; if it went forward, it would extend to the 69th. It is not material which way it be decided. The important fact is that in either case they ranged over a period of more than 75,000 years, which substantially proves my estimate of the immense reach of their chronological calendar. There are a few glyphs following the reckoning and date in the same column, but they do not assist us, nor can anything beyond the dates and a few disconnected characters be made out of the rows of glyphs around the base.

The numbers of the long series mentioned are given correctly except as to the 18 and 20, which should be 0. The reading as it stands in the inscription is as follows: 0 days, 0 chuens, 10 ahaus, 19 katuns, 17 cycles, 14 great cycles, to 1 Ahau 8 Chen. This series, as it clearly stands in the inscription, seems, as has been noted on another page, positive evidence against Mr Goodman's theory that 13 cycles make 1 great

cycle, or, according to the nomenclature we have suggested as correct—that 13 units of the fifth order make one of the sixth order. It would indicate (unless it can be shown that the 17 cycles is an error) that the system in use at Copan was the same as that in the Dresden codex, the count being 20. It is true that the series will not connect the first date (1 Ahau 8 Zip) with the 1 Ahau 8 Chen which follows, but the length of the series indicates, as we have so often found the case, that the count is back to some initial date. The order of the series, notwithstanding Mr Goodman's contrary opinion, seems to indicate that the count is forward to 1 Ahau 8 Chen. Counting back from 1 Ahau 8 Chen, year 3 Ben, we reach 12 Ahau 13 Zotz, year 5 Lamat, which would be the initial date.

Counting 20 cycles to the great cycle, as we are justified in assuming is correct, would of course put out of order Mr Goodman's tables so far as they relate to great cycles and the numbering of the cycles, though it would not affect the order of the katuns. The date 12 Ahau 13 Zotz is, as we find by his table, the first day of the sixth katun, sixth cycle of his fifty-fifth great cycle. This, however, will be further noticed when we come to the discussion of the initial series.

STELA P

I pass by Stela P, as I believe Mr Goodman's interpretation of the initial series (the only part noticed by him) to be largely guesswork, and as there are no recognizable minor series.

ALTAR Q

We turn next to the inscription on the top of Altar Q, of which Maudslay gives a large and clear photograph and a good drawing. This is to be read by double columns, as usual, commencing at the upper left hand. The first two glyphs give the date 5 Caban 15 Yaxkin. Passing over three characters, we reach another date, 8 Ahau 18 Yaxkin. There is no intermediate numeral series, but a reference to our table 1 will show that these two dates are but 3 days apart. At the bottom of the first column is the symbol for 12 days, 7 chuens, which is followed at the top of the third and fourth columns by 5 Ben 11 Muan. The 12-day numeral to the left of the chuen symbol should certainly be 13, notwithstanding the fact that Maudslay's drawing gives it as 12. An inspection of his photograph shows a middle prominence which appears to be part of a ball, though he renders it without any evident reason a cross. Counting forward 7 months and 13 days in the year 1 Akbal (in which these dates fall), on our table 2, from 8 Ahau 18 Yaxkin, we reach 5 Ben 11 Muan, which is correct. At the bottom of the third column is the symbol of 17 katuns, which does not appear to be a counter, but which Mr Goodman interprets seventeenth katun. Following this at the bottom of the fourth column is 6 Ahau, and at the top of the fifth column 13 Kayab. The next date, which is

at the bottom of the fifth column, is 5 Kan 13 Uo, between which and the preceding is the counter 4 days, 3 chuens, equal 64 days. As 6 Ahau 13 Kayab falls in the year 12 Lamat, we count forward 64 days from this date, which brings us to 5 Kan, twelfth day of the second month (Uo) in the year 13 Ben. This is correct, as Kan may be the twelfth day of the month but not the thirteenth.

The date glyphs in this inscription are of the usual form found in the Dresden codex, and the minor numerals the ordinary dots or balls and lines; and with the slight and evidently necessary corrections noted, the series conform to the rule. However, there is a break in the interpretation and calculation which remains unexplained. From 5 Ben 11 Muan, which is in the year 1 Akbal, as the preceding date, to 6 Ahau 13 Kayab in the year 12 Lamat, there is a forward jump of 37 years and 42 days unaccounted for. This appears to indicate that the 17 katuns passed over (bottom of third column) and possibly some other number glyphs should be brought into the count. Mr Goodman merely says (page 134):

> An unintelligible reckoning follows [5 Ben 11 Muan], succeeded by a 17th katun sign and 6 Ahau 13 Kayab, the date probably being indicated by the one beginning the 5th ahau of the 17th katun of the 9th cycle.

ALTAR S

We refer next to Maudslay's Altar S, the initial series on which, as given by Goodman, is 54–9–15–20–18–20—4 Ahau 13 Yax, or as we write it, fifty-fourth great cycle, 9 cycles, 15 katuns, 0 ahaus, 0 chuens, 0 days, to 4 Ahau 13 Yax. These numbers appear to be correct except the katuns, Maudslay's drawing showing 13 or 11. There are two short lines and three balls or dots, but the two outer ones are darkened with lines indicating that they may possibly be loops. Mr Goodman appears to have changed the number of katuns in this case to form connection with 4 Ahau 8 Cumhu, beginning day of his fifty-fourth great cycle, without explanation.

On this altar we find very distinctly shown these dates, 4 Ahau 13 Yax and 7 Ahau 18 Zip. Between the two are four glyphs, one of which indicates 5 katuns. This count (36,000 days) precisely connects the two dates.

We have now noticed all the series of the Copan inscriptions which afford any means of testing Mr Goodman's discoveries, following his explanations so far as this was necessary.

Inscription at Piedras Negras

Before concluding reference to the inscriptions, I call attention to one more recently discovered by Mr Teobert Maler at Piedras Negras on the Usumacinta river. This, as copied from Mr Maudslay's drawing, which he made from the photograph, is given in our figure 20. As Mr Maudslay has subjected it to Mr Goodman's theory, we give here

the result in his own words, after stating that the initial series as Goodman would read it is 54–9–12–2–0–16 to 5 Cib 14 Yaxkin:

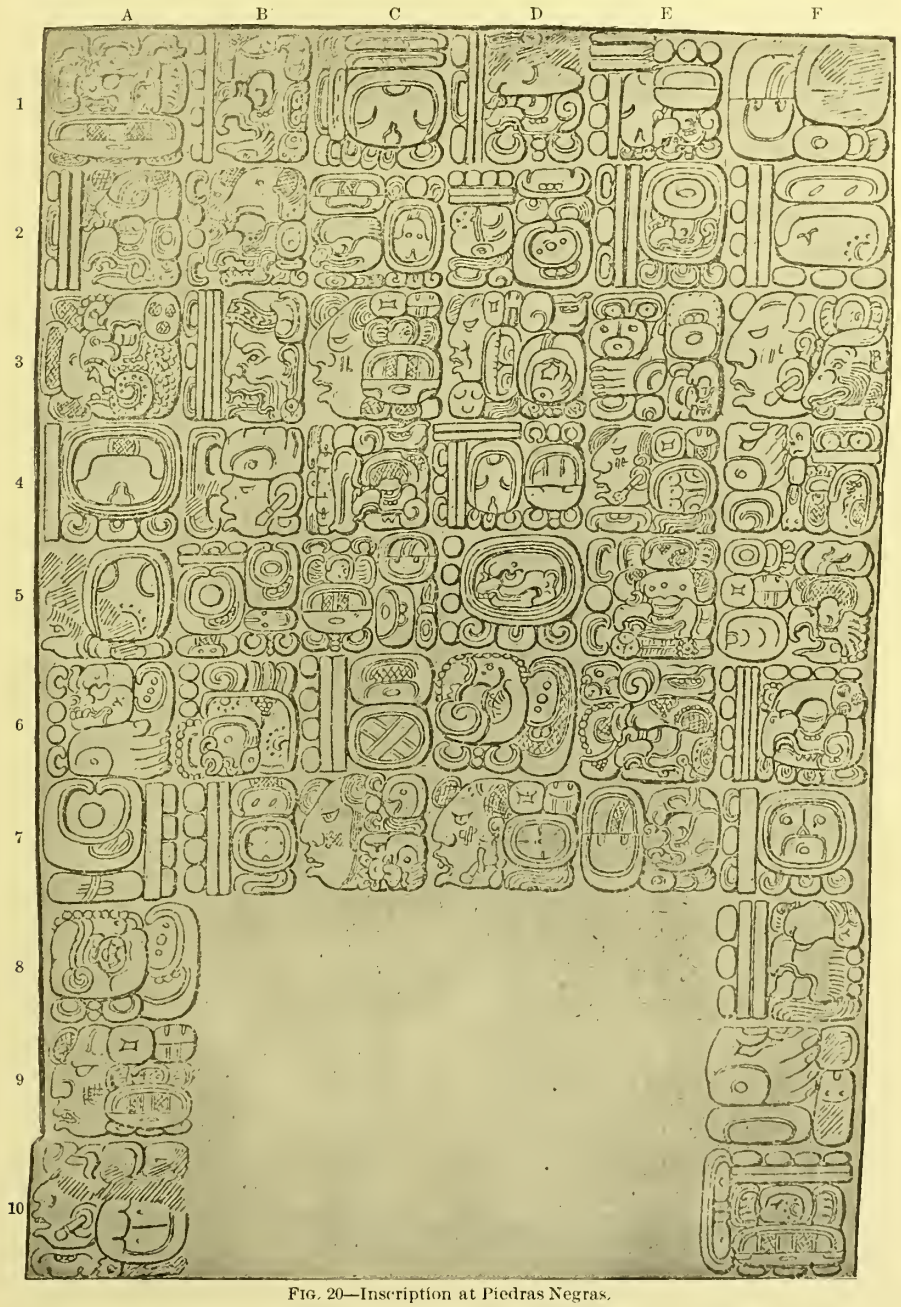


FIG. 20—Inscription at Piedras Negras.

The next three glyphs are undeciphered; then comes another reckoning:

C1 is the chuen sign with the numeral 10 (two bars=10) above it, and a "full count" sign at the side. Whether the 10 applies to the chuens or days can only be

determined by experiment, and such experiment in this case shows that the reckoning intended to be expressed is 10 chuens and a "full count" of days—that is, for practical purposes 10 chuens only, for as in the last reckoning, when the full count of chuens was expressed in the ahaus, so here the full count of days is expressed in the chuens.

The next glyph D1 is an ahau sign, preceded by the numeral 12. This gives us:

	Days
12 Ahaus (12×360)	4,320
10 Chuens (10×20)	200
	4,520
	4,380=12 years
	140

Adding 4,520 days, or 12 years and 140 days, to the date 5 Cib 14 Kankin it brings us to the date 1 Cib 14 Kankin in the thirteenth year of the annual calendar.

Turning to the inscription we find at C2 (passing over the first half of the glyph) 1 Cib followed by (the first half of D2) 14 Kankin, the date at which we have already arrived by computation.

Passing over the next three glyphs we arrive at another reckoning. D4 gives 10 days 11 chuens 1 ahau, and the first half of C5 gives 1 katun.

	Days
1 Katun	7,200
1 Ahau	360
11 Chuens (11×20)	220
10 Days	10
	7,790
	7,665=21 years
	125

Adding 7,790 days, or 21 years and 125 days, to the previous date, 1 Cib 14 Kankin, it will bring us to 4 Cimi 14 Uo in the thirty-fifth year of the annual calendar, and we find this date expressed in the inscription in the glyphs D5 and C6.[1]

Passing over the next three glyphs we arrive at another reckoning (E1), 3 ahaus, 8 chuens, 15 days:

	Days
3 Ahaus	1,080
8 Chuens	160
15 days	15
	1,255
	1,095=3 years.
	160

Adding 3 years and 160 days to the last date, 4 Cimi 14 Uo, brings us to 11 Ymix 14 Yax in the thirty-eighth year of the annual calendar; this is the date we find expressed in the glyphs E2 and F2 of the inscription.

It is true that in the sign in the glyph E2 is not the sign usually employed for the day Ymix, but that it is a day sign we know from the fact that it is included in a

[1] He counts the side number of chuen symbol, chuens.

cartouche, and I am inclined to think that the more usual Ymix sign (something like an open hand with the fingers extended) was inclosed in the oval on the top of the grotesque head, but it is too much worn for identification.

Passing over seven glyphs, the next reckoning occurs at F6, which gives:

	Days
4 Chuens.....	80
19 days	19
	99

Adding 99 days to the last date, 11 Ymix 14 Yax, brings us to 6 Ahau 13 Muan in the same year, and we find this date expressed in F7 and F8.

The last glyph in the inscription is a Katun sign with the numeral 14 above it, and a sign for "beginning" in front of it, and indicates that the last date is the beginning of a fourteenth katun. If we turn to the table for the ninth cycle of the fifty-fourth Great Cycle, from which we started, it will be seen that the fourteenth Katun of that cycle does commence with the date 6 Ahau 13 Muan.

It is simply impossible that the identity of the dates expressed in the inscription with those to which the computations have guided us can throughout be fortuitous.

Summary

Having now concluded my examination of the inscriptions, I may state that I am satisfied on the following points: That the signification and numeric value of the symbols (each represented in two or more forms) which Mr Goodman names, respectively, day in the abstract, chuen, ahau, katun, cycle, and calendar round, are as indicated above and must be accepted as correct; that the usually large (quadruple) initial glyph represents the sixth order of units, or, as Goodman terms it, great cycle; that certain face characters and also some two or three characters not face glyphs are used as number symbols. These are undoubtedly the most important discoveries yet made in regard to the signification of the glyphs in the inscriptions; and although they seem to throw but little light on the codices, they must influence, to a considerable extent, attempts at interpretation of these records.

The use of face characters for days and time periods should not be considered as something peculiar to the inscriptions, as an examination of the codices will show that this change of ordinary symbols into face forms is by no means unusual. In the Troano codex the symbol for the day Eb is oftener a face form than otherwise, and those for the days Men and Oc are often changed into faces. The symbol for the day Ix is occasionally radically changed so as to represent a face. A remarkable change in the Chicchan symbol in order to give it a face form is seen in plate 31. In one or two instances, as on plate 23, what are presumed to be symbols for the ahau have a prefixed face character possibly denoting a numeral.

We pass now to the consideration of some other questions which are brought up by this investigation.

MR GOODMAN'S SYSTEM OF MAYAN CHRONOLOGY

First, I will explain briefly Mr Goodman's interpretation of the ancient Mayan system of chronology. It must, however, be borne in mind that his "archaic chronological calendar" or system is distinct from the well-known Mayan calendar system comprising years of 365 days and 18 months, 52-year cycles, etc.

Attention has already been called to his time periods from the day up to and including the cycle, and also to the fact that these are identical with the orders of units in the Mayan system of notation, a fact which seems to negative the idea that they should be called time periods. These periods, with his names and the values assigned them, are as follows:

	1 day.
20 days make	1 chuen.
18 chuen make	1 ahau.
20 ahaus make	1 katun.
20 katuns make	1 cycle.
13 cycles make	1 great cycle.
73 great cycles make the grand era.	

If we follow him carefully throughout his work, it becomes apparent that, after he had arrived at the conclusion that the orders of units or steps in notation were veritable chronologic periods, it was a natural consequence that he should conceive the idea that the system must reach back to a number or period that would round out evenly as a great common multiple of all the lower factors. This is apparent from the following passage near the commencement of his paper:[1]

> If, as is probable, a more satisfactory answer should be found by many in the assertion that I am in error as to such an era, and I be asked how I know that it exists, my reply would be that it is self-evident. Its existence is established by all the certainty of mathematical demonstration. The evidence of the inscription does not go hand in hand with us to the ultimate destination, but it leads us far on the journey, and leaves us only when it has pointed out an unmistakable way to the final goal, which an intellectual necessity compels us to reach before we can rest satisfied. The inscriptions show us that every separate chronological period must be rounded out to completeness before the calendar itself can be complete. We see the years, ahaus, and katuns come back to their respective starting-points, thus rounding out the periods of which they are the units. Of necessity the cycles and great cycles must do the same, else the system would be an incomplete creation, without form and void. No fair-minded person, I think, will contend that the Mayas elaborated almost to its conclusion a design not only susceptible of but inviting the most perfect finish and then willfully or blindly left it disproportioned and awry. If they did not do this—a thing alien and repugnant to human nature—then their grand era embraces 374,400 years. There are two unmistakable indices pointing to this conclusion. The moment the cycle and great cycle appear upon the scene we know by the unchangeable law governing the calendar that they must go forward until they commence

[1] The Archaic Maya Inscriptions, p. 6.

again with the same date from which they started. Such a result in the case of the former requires 949 cycles, and in that of the latter 73 great cycles, each of which reckonings constitutes a period of 374,400 years.

It is also apparent in the following expression (p. 26):

The grand era is composed of seventy-three great cycles and comprises 374,400 years, or 136,656,000 days. It is the period in which the Maya chronological calendar completes itself, just as their annual calendar does in a period of 52 years.

This number of days is the product of the factors $20\times18\times20\times20\times13\times73$. Now let us examine his reason for introducing the 13 and 73 instead of carrying on the count according to the usual Maya vigesimal notation, as Dr Förstemann has done. This is easily seen. Having conceived the idea that all the factors of the calendar system are time periods and must come into harmony in the highest period, it was absolutely necessary to bring these prime numbers into the count. The 13 is necessary to the day numbering and to the 52-year period (4×13), and the 73 to the 365-day period (5×73), and as 4 and 5 are factors of the lower periods (as 20) the prime numbers only were necessary to complete the scheme. As the attempt to introduce both these into one period would have required the use of the very large multiplier 949 (see his use of it, p. 27), the 13 was introduced into the grand cycle. We might ask, and seemingly with good reason, why not in one of the lower orders? The answer is apparent—the records show beyond question that, up to the cycle, the multiplier, except in the case of the chuen, was 20. But in passing from the cycle to the grand cycle, but a single example has been found in the inscriptions showing a higher number than 13, and this, as has already been stated, Mr Goodman decides must be erroneous.

As the introduction of the 13 somewhere is absolutely necessary to round out his grand multiple, how, we may ask, was the system completed in accordance with the Dresden codex which he admits (page 3) "pertains to the archaic system in the main, though reckoning 20 cycles to the great cycle"? Unless 949 is introduced as a multiplier in the next step, which can not be supposed possible, the entire scheme is destroyed and the several steps reduced merely to those of notation, which in fact they are. The idea that the Mayan tribes of Chiapas, Guatemala, and Honduras had such a magnificent rounding-out system, while the Yucatec tribes, though having a system similar in other respects, failed to introduce the rounding-out factors, is, to say the least, very strange. In order to include the 365 days of the year in the great multiple, it was also necessary to introduce the prime number 73, which is not a divisor of any of the lower periods. This explains Mr Goodman's theory of a great cycle composed of 13 cycles and a grand era composed of 73 great cycles, as he could not otherwise have a general rounding-out period. These are of course necessary to this scheme, but the crucial question is, did the Maya have any such scheme,

or ever imagine such a one? Where is the proof to be found? The fact that the scheme works out nicely according to the figures is no evidence that it was ever in use, ever adopted, known, or even imagined by the most advanced Mayan priest.

Speaking of the grand era, his great rounding-out period, Mr Goodman says:

> As the existence of this period is very likely to be questioned, I will give my reasons more fully here for believing in such an era. The numbers 73 and 949 are as important factors in the Maya chronological scheme as 13 and 20. This results from two features of the system not hitherto touched upon, which may very properly be termed the minor and grand rounds of the periods. After 73 occurrences, and not until then, every period of the chronological calendar begins again with the same day of the same month, but (with the exception of the burner and great cycle) with a different day number. This is the minor round. Thirteen of these, or 949 occurrences, constitute the grand round, when the periods begin again not only with the same day of the same month but with the same day number.

There is no doubt that the calculation here is all right, and that 73, 13, and their multiple, 949 (73×13), will be divisors of any product of which they have been multipliers. Hence there can be no question that the results he gives in the two tables following the paragraph quoted are correct, but after all he is simply taking apart the pieces he has put together. In other words, no amount of figuring in this way will furnish proof that such a scheme as his was in vogue among the Maya. That they did have a notation with the following multipliers: $20\times18\times20\times20$, and another, presumably 20 (admitted by Mr Goodman to have been 20 in the Dresden codex) we know; but it can hardly be granted that the great scheme he has built up on this foundation is justified. There is just as much evidence, in fact much more, that the count went on after the second order of units according to the vigesimal system, than that Mr Goodman's scheme was in vogue.

That there was a count or order of units above the fifth or cycle is evident both from the codex and from the inscriptions, and I am inclined to believe, as heretofore stated, that Mr Goodman is right in interpreting the large initial glyph of the Tablet of the Cross, Palenque, and the other similar initial glyphs as the symbol of such count, order of units, or great cycle, as he prefers to call it. But I find no evidence in the codices or inscriptions that the count was ever carried beyond this sixth order of units or great cycle, though there is nothing in the system to prohibit it more than there is to prevent counting beyond billions in the decimal system. That this order of units appears to have been the limit of computation is inferred in part from the prominence and position given the symbol, and from the fact that no higher count has been found. Although there is no satisfactory evidence in the inscriptions of the numbering of these so-called great cycles, except the series on Stela N, Copan, yet it is known from the Dresden codex that they were numbered; but the limit, unless we assume that it was governed by the vigesimal system, is unknown.

That the symbols of this order forming the initial glyph of various series in the inscriptions differ in some of their parts and appendages is evident, but that these elements and appendages are used to indicate numerals has not yet been established by Mr Goodman, as is evident to anyone who will examine his explanation of the ahaus on Stela J of Copan in the quotation given above, which shows his method of arriving at the numbers indicated by glyphs. There is too much guessing in the building up of numbers by piecing together the parts to justify acceptance by those who are in search of positive results.

I have stated again and again that I believe the so-called time periods to be nothing more than the orders of units used by the Maya tribe in its system of notation. That they are the same up to the cycle, or fifth order, is known from the evidence furnished by the codices and inscriptions; and that the same vigesimal system is continued to the sixth order in the Dresden codex is admitted by Mr Goodman and proved by the series on plate 31, which has been given above (page 728). As positive proof that the nineteen cycles here are to be counted it is only necessary to state that the series connects with 13 Akbal, which may be that below or that to the left above. Let the count be either way, it begins and ends with this date.

The great time series on Stela N of Copan heretofore mentioned, which Mr. Goodman brushes aside as "not only wrong but absurd as well," deserves more consideration than has been given it. The attached numerals are of the ordinary form—balls and short lines—and are quite distinct in Maudslay's photograph and drawing. It is absolutely necessary to Mr Goodman's theory as to the Maya time system that this series be effectually disposed of. And yet, so far as any evidence bearing on the case can be found, there is no other reason for rejecting it than that it conflicts with a theory.

This series as given in the inscription is as follows: 14–17–19–10–0–0, or, written out, 14 great cycles, 17 cycles, 19 katuns, 10 ahaus, 0 chuens, 0 days. This is an immense stretch of time, amounting to 42,908,400 days, or 117,557 years and 95 days, counting 20 cycles to the great cycle, as I believe is correct, or over 75,000 years, counting 13. The great cycle symbol is in this case a face character, as are the cycle, katun, and ahau symbols. The chuen symbol, which has the days attached, is of the usual form. The day which follows is 1 Ahau 8 Chen.

If we assume that the 1 Ahau 8 Zip which terminates the initial series and is found in the column on the east side of the Stela is to be connected by the long series with the 1 Ahau 8 Chen in the column on the west side (the series being in the same column), it is true, as Goodman remarks, that the numeral series as given will not make the connection. But this fact is by no means conclusive evidence that there is an error in the series; for, in the first place, taking into consideration

the fact that there is an inscription running around the base which may or may not be a part of the whole, it is by no means certain that the aboriginal artist intended to connect these two dates by this numeral series; and, in the second place, it is possible and even probable that this long series was intended to connect the following date with some preceding initial date, as Mr Goodman insists is true with regard to series in several other inscriptions. Nor is it a rare occurrence that the first following date does not connect with the terminal date of the initial series. We think, therefore, that it is more reasonable and more in accordance with the rule in other inscriptions to conclude that this numeral series was intended to connect the date which follows with some initial date, and this, unless the count was forward, which Mr Goodman does not admit, would be far back of 4 Ahau 8 Cumhu, the first day of his fifty-fourth great cycle, to which he has commonly referred. As will be seen by reference to the quotation given above from his remarks on this series, he accepts as correct the 14 great cycles, places the date 1 Ahau 8 Chen in his fifty-fourth great cycle, and carries back the count from that date, reaching the fortieth great cycle. It is evident, therefore, on his theory, that it was not the intention to connect the two dates 1 Ahau 8 Zip and 1 Ahau 8 Chen by this series, as both, according to his own showing, fall in the fifty-fourth great cycle. As proof that this is his view, we quote his words: "I think it should be 14–8–15–10–18×20. If so, the reckoning goes back to the fortieth great cycle; if it went forward it would extend to the sixty-ninth." As he says (p. 148) that the latest date of the inscriptions is "55–3–19–2–18 × 20," and in another place that Mayan count always related to past time, it is clear that he carries this count back 14 great cycles from the fifty-fourth.

It follows, from the conclusion reached in the preceding paragraph, and from Mr Goodman's scheme, that, counting back from 1 Ahau 8 Chen, the "8–15–10–18×20" of the series "14–8–15–10–18×20," as he corrects it, should bring us to 4 Ahau 8 Cumhu, the commencement of his fifty-fourth great cycle; but it does not bring this result. It must also be admitted that, counting back, the 17–19–10–0–0 of the series as it stands in the inscription will not bring us to 4 Ahau 8 Cumhu. But it must be borne in mind, as has been stated, that counting 20 cycles to the great cycle or sixth order of units (as there are good reasons for believing is the proper method) would break up the order of Goodman's tables so far as they relate to the great cycles and the numbering of the cycles, though it would not affect the order of the katuns. The cycles, katuns, and lower periods would follow in regular order, the initial days of each depending on the day with which the count begins. As 17 is given as the number of cycles, it seems clear (unless evidence to the contrary be presented, which Mr Goodman

fails to do) that the theory of 13 cycles to the great cycle is erroneous and that the count follows the vigesimal system, as in the Dresden codex. It is significant, however, that by simply changing 1 Ahau 8 Chen to 13 Ahau 8 Chen, counting back 17–19–10–0–0 we reach 4 Ahau 8 Cumhu.

Moreover, if the Dresden codex, which, so far as appears, follows the same time system that is found in the inscriptions, can have correctly 19 cycles, where is the evidence to be found that 17 cycles would necessarily be erroneous in the inscriptions? Mr Goodman's objection seems to rest wholly on his theory of the chronologic system. This is insufficient to justify belief in such a radical difference between the systems of two records which in all other respects are so nearly alike.

Following Mr Goodman's interpretation of numeral symbols, an additional fact bearing on this question, we find in certain details of the great cycle and katun symbols. According to him, the comb-like figure similar to those on the katun symbol has the value of 20. If it plays any part in making up the numerical value of the katun, it may reasonably be assumed that it performs a similar office in connection with the great cycle symbol, of which it is a usual accompaniment. It is true that Mr Goodman has furnished no proof that this particular character is a numeral symbol denoting 20, but in accordance with his theory it should have the same value in connection with the great cycle glyph as elsewhere.

In this series we have the only evidence in the inscriptions of which I am aware that the great cycles were numbered, 14 being the highest number given. But this numbering is just as the numbering of our thousands or millions; we say 10 thousand and 10 million. In the Dresden codex four of these periods are noted in some four or five series. These are the highest counts, so far as is known, that the Maya reached, their notation seeming to have spent itself in the sixth order of units. We conclude, therefore, that, though the data are not sufficient to settle all these points by absolute demonstration, as all the evidence obtainable is against the theory of 13 cycles to the great cycle and in favor of 20, and as the only evidence as to the numbering of the great cycles indicates that they go above 13, it is safest to assume that the vigesimal system was followed throughout after the count rose above the chuen or second order of units.

It is often justifiable to advance into the field of speculation in order to clear away so far as possible obstructions to advancement and to fix the limits of investigation, but the result of speculation can not safely be used as a factor in mathematical demonstration, and Mr Maudslay has candidly stated the necessity for further investigation in this respect.

We have noticed the numbering of the ahaus by the day numbers,

thus, 9, 5, 1, 10, 6, 2, 11, 7, 3, 12, 8, 4, 13, 9, 5, 1, etc. Selecting, in a continued series of days in proper order, with the day numbers attached, any day Ahau, for instance 1 Ahau, and counting forward 360 days (Goodman's ahau period), we find that the next 360 day period begins with 10 Ahau; that the third period begins with 6; the next with 2; the next with 11, and so on in the order given above. But the same is true if we select any other day, as 1 Akbal in our table 1, or begin at any point in the continued series, counting 360 days to each step.

As Mr Goodman holds that each ahau begins with the day Ahau, it follows, according to this system, that the katuns, which contain just 20 ahaus, must begin with the same day. By this it results that katuns begin with day numbers running in the order 11, 9, 7, 5, 3, 1, etc.

This is apparent if we write out the ahau numbers—the 9, 5, 1, 10, etc.—in a continuous series and take each twentieth one. As there are twenty katuns in a cycle, the latter must also, according to this system, begin with the day Ahau. Writing the numbers 11, 9, 7, 5, 3, 1, etc., in a continuous series, and taking each twentieth one, the result will be the series 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 13, 12, 11, etc. If the correct count be, as Mr Goodman asserts, 13 cycles to the great cycle, the latter will all begin with the same day and same day number, but if 20 be the correct count, then the order will be 11, 4, 10, 3, 9, 2, 8, 1, 7, 13, 6, 12, 5, 11, 4, etc.

But after all, this kind of figuring is a mere source of amusement except where the knowledge conveyed may aid to more certain and rapid counting. It is as though we were to take the days of our almanac in regular order as named, beginning the first hundred with Sunday; the second hundred would begin with Tuesday, and so on. By taking these and placing them in consecutive order we could pick out every tenth one as the beginning of the thousands. This might amuse us, and might under possible circumstances be an aid to us in counting time, but it would be no explanation of our calendar system, and would not be a part, but a result thereof.

That these ahaus or 360-day counts always began, as Mr Goodman asserts, with a day Ahau, is not proved; moreover, there is no reason for believing the assumption to be correct, but there are on the contrary, good reasons for believing it to be incorrect. It may be true, as will seem to be the case from what follows, that Ahau was more usually selected as an initial date than any other day, is, in fact, the initial day in most of the inscriptions and is also prominent in the Dresden codex, because, perhaps, some great event took place or was supposed to have taken place on a day Ahau. But it can be demonstrated that the initial day of some of the series in the Dresden codex where the 360-day period is one of the counters is Kan, which, in these, is necessarily the beginning of the ahau count. It is true, however, that the ahau or 360-day period must, if the succession be continuous and unbroken, begin on

the same day, a fact to which I have heretofore called attention (see The Maya Year, pages 47 and 53). But the series may be arbitrary; that is, the engraver or painter may have chosen to begin one series with one day and another with another day. This, however, goes to the very root of the subject, as Mr Goodman's system absolutely requires that the ahaus or 360-day counts shall all begin with the same day, and as worked out by him with a day Ahau. Dr Seler, impressed by the result of Dr Förstemann's investigations, has been led to believe that most of the series of the Dresden codex have 4 Ahau 8 Cumhu as their initial date, or the day to which they refer. While I admit that this is undoubtedly the day which seems to be most prominent in this codex, my investigations do not lead me to indorse his conclusion.

Now, it is true that the series on plates 46–50 of the Dresden codex, of which there are in reality 39 sectional, or 3 complete, have Ahau as the initial day, but the initial days of the three series are not all 360 days or an even multiple of 360 days apart, as they should be if Mr Goodman's theory be correct. But the series are all exact multiples of 260, showing that they are based on a 260-day period.

The long series on plates 51–58 does not commence with the day Ahau, whether we consider the upper line or lower line of days the proper one to count back from. It is also apparent that in this case the series is based primarily on the 260-day period. As the least common multiple of 260 and 360 is 4,680, it does not appear possible to bring those series based on the 260-day period into harmony with the Goodman theory except where the total number of days is a multiple of 4,680, unless we suppose that there are two series of non-coincident factors running through them. It is true that we may use the week of our calendar in counting 100-day periods by allowing for the supplementary days, as is undoubtedly done in some of the series of the codices and inscriptions; but the theory that the ahaus are time periods which can not overlap (thus indicating two starting points not consistent with the idea of uniform unbroken succession) is the point aimed at in the above references to the series of the Dresden codex. Another point in connection with the series on plates 51–58 difficult to account for on this theory is that the first day of the chuens (supposing the numbers in the lower order of units to represent the day of the chuen) is Muluc throughout. It is true that the number in the lower order of units may commence anywhere in the chuen, but if these are fixed time periods and the chuens (but not true months) as well as the ahaus commence with Ahau it seems that such important series as this one would reveal this fact somewhere in the reckoning. In the inscription at the end there are two symbols of the usual type, one indicating 1 katun, the other 13 ahaus=11,880 days, while the sum of the series is 11,960, or 80 days more.

The series on plates 71–73 has, if we may judge by the numbers

in the lower order of units, Ben as the first day of the chuens, and 5 Eb as the first day of the series. While these examples do not furnish positive proof in regard to the question at issue, they at least, in connection with what has been presented concerning the plan and object of these reckonings, do indicate that the so-called time periods are merely orders of units and not chronologic periods always coming in regular order from a fixed point in time.[1] Nevertheless, it must be admitted that most of the initial series in the inscriptions, as will clearly appear when their reckoning is presented, begin with Ahau, which fact must receive a satisfactory explanation before this question can be considered settled.

Another fact to be borne in mind is that according to Mr Goodman's idea, if a katun begins with Ahau, all the chuens or 20-day periods must commence with the same day, though not the same day number, and this would continue indefinitely. The same thing, however, would be true in this scheme were any other day selected as the initial date; all that will apply in any respect to Ahau will, until the year count comes into play, apply in every particular to any other day, a statement which admits of positive demonstration. The only reason for preferring Ahau, if there be any, is historic, or rather mythologic, as many of the series cover too great lapses of time to be historic.

If the two ahau symbols in the inscription in the Temple of Inscriptions of Palenque, referred to above on page 774, be counters in the time series with which they are connected, they certainly occupy the katun place. As they present the true ahau form, it may be possible that they bear some relation to the name of the period for which they stand. This, however, is at best but a mere guess, and the names are of but minor importance in the discussion.

INITIAL SERIES

Taking up now the initial series of the inscriptions, I shall give the beginning day of each and briefly discuss its bearing on Goodman's theory of the Mayan time system. The list so far as noticed by this author is as follows, using his notation, but substituting naught for full count:

Palenque Inscriptions.

(*1*) *Tablet of the Cross*—53–12–19–13–4–0 to 8 Ahau 18 Tzec. This connects, by counting back, with 4 Ahau 8 Zotz, the beginning day of Goodman's fifty-third great cycle. Here the numerals prefixed to the time periods are face characters for which we must take Mr Goodman's rendering (see what has been said above on pp. 773–760).

[1] After this paper was in print I discovered the connections of the high series running up through the serpent figures on plates 61, 62, and 69. These prove beyond question that 20 cycles (or 20 units of the fifth order) are counted to the great cycle (or unit of the sixth order), and that the initial date of these is in some instances Kan. It is my intention to discuss these series in the supplemental paper mentioned above.

(*2*) *Tablet of the Sun*—54–1–18–5–3–6 to 13 Cimi 19 Ceh. This connects with 4 Ahau 8 Cumhu, the beginning day of the fifty-fourth great cycle. Here also the prefixed numerals are face characters.

(*3*) *Tablet of the Foliated Cross*—54–1–18–5–4–0 to 1 Ahau 13 Mac. This connects with 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle. Here also the prefixed numerals are face characters.

(*4*) *Temple of Inscriptions*—54–9–4–0–0–0 to 13 Ahau 18 Yax. This as given by Mr Goodman connects with 4 Ahau 8 Cumhu, but has certainly been interpreted almost wholly by pure guesswork. The glyphs are nearly obliterated, but enough remains to show that the prefixed numerals were of the ordinary form, balls and short lines (see notes below).

(*5*) *Inscribed Steps, House C*—55–3–18–12–15–12 to 8 Eb, 15 Pop. This, as given by Mr Goodman, connects with 4 Ahau 3 Kankin, the first day of his fifty-fifth great cycle, but he admits that the prefixed numerals, all of which are face characters and badly damaged, have been determined otherwise than by inspection.

Copan Inscriptions

(*6*) *Stela A*—54–9–14–19–8–0 to 12 Ahau 18 Cumhu. This connects with 4 Ahau 8 Cumhu, initial day of the fifty-fourth great cycle. The prefixed numerals are of the ordinary form, balls and short lines, and are quite distinct.

(*7*) *Stela B*—54–9–15–0–0–0 to 4 Ahau 13 Yax. This connects with 4 Ahau 8 Cumhu, initial day of the fifty-fourth great cycle. The prefixed numerals are of the ordinary form, balls and short lines, and are distinct.

(*8*) *Stela C*—First inscription: 55?–13–0–0–0–0 to 6 Ahau 18 Kayab. This does not connect with the first day of either of Goodman's great cycles (fifty-third, fifty-fourth, fifty-fifth). The only counter of the initial series has the prefixed numerals of the ordinary form, quite distinct.

Second inscription: 55?–13–0–0–0–0 to 15? (9?) Ahau 8 Cumhu? This makes no connection with the beginning day of either of Goodman's great cycles. The prefixed numerals to the single counter are of the ordinary form and distinct. For further notice of these series, see reference to Stela C on a preceding page and remarks below.

(*9*) *Stela D*—54–9–5–5–0–0 to 4 Ahau 13 Zotz. This connects with 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle. The prefixed numerals are in this case peculiar, being complete forms.

(*10*) *Stela F*—54–9–14–10–0–0 to 5 Ahau 3 Mac? (according to Goodman). This also connects with the first day of the fifty-fourth great cycle, using the series as given by Goodman; the series is, however, wholly made up by this author, as there is nothing in the inscription and no glyphs obliterated or otherwise to indicate it, the date following immediately after the great cycle symbol.

(*11*) *Stela I*—54–9–12–3–14–0 to 5 Ahau 8 —?, the month symbol being unusual; Mr Goodman says it should be Uo. This connects with 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle, if we adopt Mr Goodman's interpretation of the month symbol. The prefixed numerals are of the ordinary form and are very distinct.

(*12*) *Stela J*—West side: 54–9–12–12–0–0 to 1 Ahau 8 Zotz (as given by Goodman). This connects with 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle, according to the counters as here given. The prefixed numerals are of the ordinary form and are mostly distinct, but there is great uncertainty as to the order in which the glyphs are to be taken.

East side: 54–9–13–10–0–0 to no recognized date; Goodman says it should be 7 Ahau 13 Cumhu, presumably reached by counting from 4 Ahau 8 Cumhu, first day of his fifty-fourth great cycle, but in this case he has made a mistake, as the connection is with 7 Ahau 3 Cumhu. The prefixed numerals are of the ordinary form and are distinct, but the order in which the glyphs come is very doubtful (see remarks below).

(*13*) *Altar K*—54–9–12–16–7–8 to 3 Lamat 16 Yax. This connects with 4 Ahau 8 Cumhu, the first day of the fifty-fourth great cycle. The prefixed numerals are of the ordinary form, but some of the glyphs are defaced and some of the numbers do not appear to agree with those given by Goodman (see remarks below).

(*14*) *Stela M*—54–9–16–5–0–0 to 8 Ahau 8 Zotz. This connects with 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle. The prefixed numerals as given in Maudslay's drawing (the photograph is not given) are of the ordinary form and correspond with the numbers given here.

(*15*) *Stela N*—54–9–16–10–0–0 to 1 Ahau 8 Zip (Goodman says that the month numeral is wrong here and that it should be 3 Zip). This will connect 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle, with 1 Ahau 3 Zip, but not with 1 Ahau 8 Zip. The prefixed numerals are of the ordinary form, are quite distinct, and agree with those given.

(*16*) *Stela P*—54–9–9–10–0–0 to 2 Ahau 13 Pop. This connects with 4 Ahau 8 Cumhu, first day of the fifty-fourth great cycle. The prefixed numerals are unusual face characters, and the result appears to have been reached by Mr Goodman by appeal to his chronological system.

(*17*) *Altar S*—54–9–15–0–0–0 to 4 Ahau 13 Yax. This connects with 4 Ahau 8 Cumhu, the first day of the fifty-fourth great cycle, according to Mr Goodman's figures here given. However, the prefixed numerals, which are of the ordinary form and distinct in Maudslay's drawing (the photograph is not given), do not appear to agree with Goodman's figures (see remarks below).

As I do not have Maudslay's photographs and drawings of the Quirigua inscriptions I will omit them from consideration here.

Examining these different series and noting Goodman's explanations

and comments, we soon perceive that the data on which to base a decision in regard to his interpretation of these initial series are rather meager. In six of them the prefixed numerals are face characters, so that the result depends entirely on the correctness of Goodman's interpretation, in regard to which the proof is as yet entirely lacking. A more thorough examination of all the inscriptions containing face numerals, including those of Quirigua, photographs of which are not yet at hand, is necessary before this question can be decided. There are two, I believe, in which connection can be made between the terminal date of the initial series and dates which follow. But this is not positive proof of correct rendering where the series runs into high numbers, as do all the initial series. This will be understood by the statement that one, two, or more calendar rounds may be dropped out of the aggregate and yet the result will be the same if the prefixed numerals are changed to accord with this result; in other words, the same remainder in days will be left in the one case as in the other. This is possible, but it is not possible to change the time periods so as to give the same result where the sum is less than a calendar round, as one of the higher periods embraces all and more than all the given lower periods. However, we may accept his interpretation where the terminal date of the initial series connects with the date which follow. The uncertain and somewhat suspicious element in the investigation is the evidence in some cases and indication in others that Mr Goodman has obtained his series not from the characters, but from his system. In these cases it is evident that connection of the terminal date by the series with the initial date proves nothing more than the correctness of his calculation. For this reason none of these are considered as evidence of the general use of a certain initial, except where there is connection with a following date through a following series. The two or three instances in which this is the case have been specially referred to. As bearing on this point, the following facts are noted:

The initial series in the Temple of Inscription (4 in the above list) is so nearly obliterated, as appears from Maudslay's photograph, that it is impossible to determine the prefixed numerals or the terminal date. The 4 (katuns) is the only distinct number in the series. Enough of the day number, given by Goodman as 13 Ahau, remains to indicate that his rendering is wrong. There are (as is also shown in Maudslay's drawing) two short lines denoting 10, but the dots or balls are obliterated; there is, however, the little loop remaining at one end. As a rule which has no known exception, unless this be one, there are never more than two balls between these end loops, usually but one (see the quotation on this from Maudslay given above). As there would have to be three to give the 13, either Mr Goodman is wrong or the inscription is irregular. This series must therefore be excepted from those offering evidence in favor of this author's theory.

The series on the inscribed steps (5 of the list) Mr Goodman admits has been determined otherwise than by inspection, and hence it must be excluded.

Series 6 and 7 of the above list (Stelæ A and B) must be accepted as evidence, as the prefixed numerals are of the ordinary form, are distinct, and make connection with the initial date of Goodman's fifty-fourth great cycle.

The two inscriptions on Stela C (8 of above list) present one unusual feature, and one which seems to bear very strongly against Mr Goodman's theory of 13 cycles to the great cycle, in fact is almost positive evidence against it. Here, following Mr Maudslay's drawing—for his photograph is not sufficiently plain for satisfactory inspection—we notice that but one time period is given, 13 cycles, and that this is followed without any intervening glyphs by the date 6 Ahau 18 Kayab. The day symbol is a face character, but is so rendered, and seemingly correctly, by Goodman. This will not make connection with the initial date of either of the three great cycles given by him. The fact that the numeral in this case (balls and short lines) prefixed to the cycle symbol is 13 appears to stand in direct contradiction of this author's theory, as "full count" is nowhere else given in ordinary numerals or even in a face character, but always in one of the symbols for full count. We never find in ordinary numerals 20 days, 18 chuens, or 20 ahaus, etc., nor has Mr Goodman in any case rendered a face character by either of these numbers.

The other inscription on this stela is also unusual in the same respect, the numeral series consisting of only one time period—13 cycles—which is followed immediately by the date 15? Ahau 8 Cumhu. The 15 prefixed to Ahau is evidently an error. Mr Maudslay, though giving 15 in his drawing, concludes, from a subsequent examination, that it may be 9 or 5. However, it will not connect with the first day of either of Mr Goodman's great cycles, whether we use the one or the other number or any other Ahau 8 Cumhu. These two initial series taken together present another fact difficult to account for on Mr Goodman's theory. They have precisely the same counters—13 cycles—but reach different terminal dates. This could not be true if the dates are in the same great cycle, and if in different ones they would necessarily be precisely one or two great cycles apart, as Mr Goodman limits the inscriptions to the fifty-third, fifty-fourth, and fifty-fifth. In his comment on these series he virtually confesses his inability to determine the number of the great cycle by the details of the glyph.

The inscriptions on the east and west faces of Stela J are placed irregularly, in one case in three columns and transverse lines, and in the other in diagonal lines; the order, therefore, in which the glyphs are to be taken is very uncertain.

According to Maudslay's drawing of Altar K (no photograph is given), the initial series of the inscription as given by Goodman does

not appear to be correct. The drawing shows 12 or 14 cycles and not 9, unless the two short lines are to be considered as one, which can only be determined by inspecting a photograph or a cast.

The initial series of Altar S (17 of the above list) as given by Mr Goodman does not correspond throughout with that of the inscription as given in Maudslay's drawing (there is no photograph). He gives 15 katuns, whereas the inscription shows only 13, the prefixed numerals being of the ordinary form.

Although the evidence presented is not sufficient to establish Mr Goodman's theory of a distinct Mayan time system, it, together with the very frequent references in the Dresden codex to the day 4 Ahau 8 Cumhu (which always falls in the year 8 Ben), indicates that this date was considered one, perhaps the chief, initial point in the time series. Dr Förstemann has called attention to its use in this codex in his Zur Entzifferung der Mayahandschriften and in a letter to me.

Neither of the high series running up the folds of the serpent figures of plates 61 and 62 appear to begin or end with Ahau. The black series in the right serpent of plate 62 over 3 Kan 17 Uo (the 16 is an evident error) reaches back, if counted from this date with 20 cycles to the great cycle, to 12 Chicchan 8 Xul; or, counted with 13 cycles to the great cycle, it reaches 10 Chicchan 18 Pax.[1] But it is noticeable that at the bottom of the plate (62) at the right of these serpent figures and extending into plate 63 are five short series with 4 Ahau 8 Cumhu as the given date in each. The red loops here seem, as I have shown on another page, to indicate connecting series, as some of them connect with the dates immediately above.

The series in the upper left-hand portion, accompanied by loops, terminate with 4 Ahau 8 Cumhu, but go back to 9 Ix counting either or both series of the column, that with the loops and that above 9 Ix.

The series running through the middle and lower divisions of plates 72 and 73 starts with 4 Eb. The two high series at the right of the upper division of plate 52 go back to 4 Ahau 8 Cumhu.

It will be seen from this discussion that while 4 Ahau 8 Cumhu is a notable initial date, it is not the only one with which series running into years commence, and that Ahau is not the only initial day in long series. There is, however, one noticeable difference between the initial series in the inscriptions and the series in the codices; in the former the symbol of the highest or sixth order of units is a marked character which has no parallel in the latter, but it must be remembered that in the latter the distinction between the orders of units is made by the position of the ordinary counters and not by distinct symbols, as in the former.

One fact which must be borne in mind in connection with this point is that Ahau can not be the first day of a year or month in Mr Goodman's system, nor in any Mayan system. It follows, there-

[1] See footnote on page 800.

fore, that neither of his large periods—cycle and great cycle—can begin with the first day of a year. This, however, is true of most, if not all, of the series of the Dresden codex, which goes far toward proving that Mr Goodman's supposed time periods are not really such in a true sense, but are simply time counters or orders of units; otherwise we must suppose that the Maya had two time systems coincident only at certain points, which is what Mr Goodman assumes.

Why the calendar used should be called "Archaic," as compared with that of the codices, is not altogether apparent from the inscriptions examined. As given and explained by Mr Goodman, it was as complete and perfect in all its details as that which would be designated more recent. The months, years, and 52-year periods, the method of numbering the days, and hence the 4-year series and all the peculiarities of the system, were precisely the same as those of the codices. As it is a rule in the progress of human culture to advance from the imperfect and crude to that which is more nearly perfect, that the archaic Maya calendar system might be expected to exhibit imperfections which were gradually remedied by experience. Dr Förstemann, reasoning on this very justifiable assumption, concluded (though we must admit he fails to present satisfactory evidence) that primarily their years consisted of only 360 days, and that the next step in advance was to a year of 364 days, the final correction resulting in the year of 365 days. Mr Goodman says (page 3) that the Cakchiquel time system included two different years, the calendar year consisting of 366 days, and the chronologic year of 400 days (it was 400 days). His scheme includes not only a 360-day period, but carries with it the 365-day period or true year, as this is one of his essential factors, and moreover is apparent in almost every inscription and must be admitted as a part of the chronologic system of the oldest inscribed records which have been discovered, be our theory as to their time system what it may.

IDENTITY OF SYSTEMS AND CHARACTERS OF THE DIFFERENT TRIBES

That there are found in the inscriptions on the now ruined structures of Tabasco, Chiapas, Yucatan, and Central America forms for the months and for some of the days, as well as some other peculiarities in symbols, not observed in the codices, is true. But considering what has been given by early writers concerning the names and order of the days and months among the different tribes, the agreement in the forms and order of the days and months as shown by the inscriptions is remarkable. Take the day Ahau for example; although we meet here and there a face form, yet the usual symbol at Palenque, Tikal, Menche, and Copan is the same as that found in all the codices. The same is true of Ik, Akbal, Kan, Ben, Ezanab, Imix, and some others. And each holds the same relative position throughout, which indicates

a sameness and uniformity at variance with the idea of any difference in system, or any great difference even in nomenclature.

Several of the month symbols, as Pop, Zip, Zotz, Xul, Yaxkin, Mol, Yax, Kayab, Cumhu, and in fact nearly all, are substantially the same as those found in the Dresden codex, which is the only codex in which the months have as yet been discovered. This similarity would seem to indicate that the names among the different tribes have not always been correctly given by the early writers. In fact, the codices and inscriptions show greater uniformity in regard to the time system and time symbols than is to be inferred from the historical record. Each section introduces some glyphs not found in other sections, and there is more or less variation in the ornamentation and nonessential features, but the typical forms of the time symbols are generally essentially the same.

The evidence, when carefully examined in detail, presents some facts which seem to demonstrate the correctness of the above conclusion, and to show that the testimony of the early authorities indicates a greater difference in systems than is indicated by the inscriptions.

The names and order of the days of the month used by the Maya (proper), Tzental, and Quiche-Cakchiquel tribes, as based on the historic evidence, are as follows:

	Maya	Tzental	Qui.-Cak.
1	Imix	Imox	Imox
2	Ik	Igh	*Ik*
3	Akbal	*Votan*	Akbal
4	*Kan*	Ghanan	Kat
5	Chicchan	Abagh	Can
6	Cimi	Tox	Camey
7	Manik	Moxic	*Queh*
8	Lamat	*Lambat*	Canel
9	*Muluc*	Molo	Toh
10	Oc	Elab	Tzi
11	Chuen	Batz	Batz
12	Eb	Euob	*Ee*
13	Ben	*Been*	Ah
14	*Ix*	Hix	Balam
15	Men	Tziquin	Tziquin
16	Cib	Chabin	Ah mak
17	Caban	Chic	*Noh*
18	Ezanab	*Chinax*	Tihax
19	*Cauac*	Cahogh	Cooc
20	Ahau	Aghaual	Hunahpu

The names in italics are the supposed dominical days. Some of the names in these lists are but equivalents in the different tribal dialects, but this does not apply to all, as is evident from the efforts of Dr Brinton and Dr Seler to bring them into harmony.

Although uniformity in the form of the day symbols does not prove identity in the names in the different tribal dialects, it tends in this direction, if allowance be made for the variation necessary to express the same idea, and undoubtedly indicates unity of origin. Take, for example, the day Votan in the Tzental calendar, which stands in the place of Akbal in the other calendars. The symbol of this day is remarkably uniform in all the inscriptions where it appears. The same is true in regard to Kan, Lamat, and Ezanab, which never appear as face characters. As it is admitted that Votan or Uotan is not equivalent to Akbal, Kat to Kan, nor Canel to Lamat, how are we to account for the uniformity of the symbols in the several regions that these tribes are known to have inhabited?

However, the widest variation between the historic evidence and that of the inscriptions is in reference to the names of the months. In regard to these, as given historically, it may be stated that those of the Maya (proper) and the Tzental-Zotzil and Quiche-Cakchiquel groups differed throughout, morphologically and in signification, so far as the latter has been determined, no name in one being the same, save in a single instance, as that in another. As compared with those in the Maya calendar, which have already been given, those of the Tzental were 1, Tzun, 2, Batzul, 3, Sisae, etc.; those of the Quiche, 1, Tequexepual, 2, Tziba pop, 3, Zac, 4, Ch'ab, etc., differing in like manner throughout. So widely different, in fact, are they, that Dr Brinton and Dr Seler made no attempt to bring them into harmony. Now, in contrast with this, the symbols are not only comparatively uniform in the inscriptions, as is shown by the figures given in Mr Goodman's work, but, with very few exceptions, correspond with those in the Dresden codex. There are also indications that the names were the same as those found in the Maya calendar. For example, the symbol of the month Pop is characterized by an interlacing figure apparently intended to denote matting; in Maya, Pop signifies "mat." The name of the fourth month, Zotz, signifies "a bat," and the symbol, which is always a face form, has an extension upward from the tip of the nose, presumably to indicate the leaf-nosed bat. But as conclusive evidence on this point, if Mr Goodman is correct in his interpretation, the month is designated on one of the Stelae at Copan by the full form of a leaf-nosed bat. So general is the uniformity of the month glyphs, both in the Dresden codex and in the inscriptions that Mr Goodman has not hesitated to apply to all the names of the Maya calendar, and to place side by side those of the inscriptions and those of the codex. "There is not," he says, "an instance of

diversity in all their calendars; their dates are all correlative, and in most of the records parallel each other." Of course there are sporadic variations and imperfect glyphs which often render determination by simple inspection uncertain, but it is generally aided by the connecting numeral series.

The change of day symbols from the typical form to face characters is found in the codices as well as in the inscriptions, as is shown by an examination of the Troano codex, where it is of frequent occurrence. The occasional variations of the symbols for the days Chicchan, Cimi, and Ix, in the latter codex, are so radical that identity is ascertained only by means of the positions they occupy in series. It is upon this uniformity Mr Goodman chiefly bases his theory of an archaic calendar. Following the quotation given in the preceding paragraph he says (pp. 145–146):

From this is deducible the important fact that—whether a single empire, a federation, or separate nations—they were a homogeneous people, constituting the grandest native civilization in the Western Hemisphere of which there is any record. Yet when the Spaniards arrived upon this theater of prehistoric American grandeur, there was not only no powerful nation extant but no tradition or memory of former national greatness. The very sites of the ancient capitals were unmentioned, nameless, unknown. This obliviousness could not result from the passage of a few score or a few hundred years. It could only come in the wake of a period that had outlasted the patience and retentiveness of even aboriginal minds. Next, Dr Otto Stoll, the distinguished comparative linguist, who has made a special study of the Maya dialects, states that the Cakchiquel language, one of the most nearly affined to that of the Tzentals, who at present occupy the central seat of the extinct empire, is yet different enough to require a period of at least two thousand years to account for the divarication. This points to a remote date of separation, though indefinite. Thirdly, we find in the Yucatec chronicles a definite indication singularly in keeping with Dr Stoll's estimate. All the Xiu chronicles begin with a record of the migration of their ancestors, in two great bodies, about two hundred and forty years apart, from some region to the westward.

From long and careful study of the annals I have come to the conclusion that these migrations took place respectively about 353 and 113 years before the beginning of our era. That this migration could have come from the Archaic nation only is proved by the identity of the graphic system of the Yucatecs with that of Palenque, Copan, Quirigua, and other cities of the central region—a system found nowhere to the north, south, or west of it. Even to this day the Yucatec language is more closely allied to that of the Tzentals and Zotzils of that same region than to any of the other numerous Maya dialects. That the Yucatec calendar and chronological system differ in several respects from those of the Archaic cities is not a final or even grave objection to this theory, but only what under the circumstances might be expected. The Xius found the Cocoms and Itzas, older offshoots of the Maya race, already in possession of Yucatan, and appear always to have acted a subordinate part to them in subsequent history. It is not unlikely, therefore, that they changed their methods of computing time so as to conform to those of their superiors; or the change may have been made for some reason not evident to us; but that they did change their methods there can be no doubt, and that, too, shortly after their contact with the other nations. Two of their chronicles distinctly state that at a time equivalent to about the 257th year of our era "Pop was put in order." The statement can refer

only to a rearrangement of their calendars, for the calendars themselves had been in existence for unknown centuries; hence, these records probably denote the time at which they changed their chronological methods to conform to those of their neighbors. Our best hope of correlating the calendars lies in the discovery of some record made by the Xius in their new home previous to this change.

The difficulty in this theory lies in the fact that precisely the same calendar system continued down to the coming of the Spaniards, at least in some of the districts. This is proved by the codices, some of which we know were in use down to that time, though possibly understood only by the priests, and the radical differences in the month names seems to have been of comparatively recent date. The same general system, allowance being made for differences in names and forms of symbols, was also found, as has already been mentioned, among the Aztec, Zapotec, and some other stocks. In fact, except for the differences in the names of the months and of some of the days, the change of dominical days by the people among whom the Troano codex was written, and some difference in counting the months which seems to have obtained among some of the Cakchiquel, the calendar system was uniform among the Mayan tribes from the first notice we have of it to the coming of the Spaniards. The idea, therefore, advanced by Mr Goodman of an "Archaic calendar," which ceased to be in use about the time of the Xiu migration, between sixteen hundred and two thousand years ago, appears to be without valid basis.

Finally, on this point I think I will be justified in the statement that if the archaic Mayan chronologic system was so complete and perfect as it is believed by Mr Goodman to have been, it was the most systematic, orderly, and complete time system ever known to the world, not only outranking in this respect the oriental systems, but even those of modern civilization. We are therefore compelled from our examination of the subject, while commending as exceedingly valuable his real discoveries, which have been noticed, to reject his theory in regard to the ancient Mayan chronologic system, so far as it differs from that generally received, believing that he has mistaken the notation used by this ancient people in counting time for a veritable time system.

One somewhat startling result of Mr Goodman's theory in regard to the Mayan time system is the conclusion reached by him in reference to the range of time over which the history of the Maya people has extended. This is shown in the following extract from his work:

> Let us, finally, consider for a moment the possibilities of duration for that Maya empire. The Mayas were a primitive, pure-blooded, united people. No ancestral prejudices or racial jealousies could spring between them. Whatever tendencies there were dependent on the inscrutable laws of nature must all have been in common. They were strong in numbers, and stronger still by their great and solitary enlightenment. They occupied a territory that is practically a fortress. To the east, south, and west there is not area enough to harbor savage foes in numbers that would have been formidable even if coalesced, and to the north, if necessary, they could oppose their united forces. No other great nation ever occupied so secure a position. Hence

the question of danger from outside sources is practically eliminated from the problem of their national existence. Their unity of origin, the simple numeral worship indicated by their monuments, the civic spirit to be inferred from the absence of all warlike insignia in the inscriptions, point unmistakably to a happy, contented, peaceful state of internal affairs, akin to brotherhood. Under such conditions, how long might not a nation endure? We go back ten thousand years and find them then civilized. What other tens of thousand years may it have taken them to reach that stage? From the time of the abrupt termination of their inscriptions, when all suddenly becomes a blank, back to that remote first date, the apparent gradations in the growth of their civilization are so gradual as to foreshadow a necessity for their 280,800 recorded years to reach the point of its commencement. Manifestly, we shall have to let out the strap that confines our notion of history. The field of native nationality in America promises, when fully explored, to reveal dates so remote that it will require a wider mental range to realize them (page 149).

This conclusion is reached by the following process of reasoning: That the concluding date (he always calls it "initial date") of the initial series "could have but a single purpose—that of recording the date at which the monument was erected." The fact that some of the stelæ have different "initial dates" on opposite sides is explained by the statement that "in these instances one date is reckoned from the other, the latter one undoubtedly designating the time of dedication." This, however, is a supposition not sustained by satisfactory evidence. As to the two on Stela C, he confesses he can give no explanation of them without radical changes in each.

By a comparison of the dates in the various inscriptions he arrives at the conclusion that the lapse of time between the earliest and latest of these was 8,383 years. Adding to this 2,348 years, the time preceding 1895 A. D., at which he thinks the record closed (page 148), "we shall arrive at the time when that ancient Maya conqueror trod his enemies under foot, 10,731 years ago, the oldest historical date in the world"; that is to say, the monument on which the earliest date is recorded was erected 8,836 years before the Christian era. To obtain the enormous stretch of 280,800 years, mentioned in the above extract, he counts back according to his theoretic time system to the beginning of the grand era. Of course, such startling result, based upon the kind of testimony offered, can hardly be accepted as historic. The inscriptions showing what may be called "initial series" exist; they show the counters up to the sixth order of units, or the great cycle, but all else upon which his great structure is built consists of speculation. There is no basis for his grand era, his 73 great cycles, or his fifty-third, fifty-fourth, and fifty-fifth great cycles. That the great cycles were numbered, just as we number thousands and millions, is undoubtedly true, but 14 is the highest numbering of which we have any positive evidence in the inscriptions or codices, which indicates that the count would have ended at 20, following the vigesimal system if carried higher.

Notwithstanding these criticisms Mr Goodman seems to be right in

his conclusion that, at the time the inscriptions were chiseled and the codices formed, the Maya people were in a much more homogeneous state and tribal distinctions much less marked than when described by the early Spanish writers. Dr Brinton says that "in all the Mayan dialects the names [of the days] belonged already at the time of the conquest to an archaic form of speech, indicating that they were derived from some common ancient stock, not one from the other, and that, with one or two possible exceptions, they belong to the stock and are not borrowed words." Though we can not say positively to what tribes the inscriptions of the different districts are to be respectively attributed, we can safely assert that they are Mayan, and that those at Palenque are in what is or was the country of the Tzental and Chol tribes; those at Menche (or Lorillard City) in the Lacandon country; those at Copan and Quirigua in the habitat of the Quiche and Cakchiquel or possibly Chol peoples; and those at Tikal in that formerly occupied by the Itza tribes. The great similarity in the time and numeral symbols and the time systems shown by the inscriptions in these different localities would seem, therefore, to justify Mr Goodman's assertion "that—whether a single empire, a federation, or separate nations—they were a homogeneous people," and thus, though these records have so far failed to furnish any direct historic data and seem likely to fail to furnish any by further investigation, they do form indirectly a firm basis in our attempts to trace the past history of this people. The next step is to determine the age of the records, for, as appears from what has been shown, the history as derived from the early Spanish writers can not be fully relied on, and the traditions can be trusted only so far as they agree with the monuments and the linguistic evidence. That Mr Goodman's conclusion in reference to their age can not be accepted is evident from the quotation given above.

One conclusion which appears to be justified by the foregoing facts is that the Maya of Yucatan represent the original stock, or that they have retained with least change of any of the tribes the names and time system of the calendar, except as to the dominical days.

NUMERAL SYMBOLS IN THE CODICES

Before closing this paper I will, for the benefit of those who have recently taken up the study of the Maya manuscripts and inscriptions, refer to some symbols found in the codices which probably represent numbers. The study of these may, if followed up by further investigation in the light of Mr Goodman's discoveries, lead to fruitful results in attempts at interpretation of the codices.

In the Dresden Codex

The katun symbol in the ordinary form shown at *a*, figure 10, is very frequently used in this codex, sometimes, as already shown, as one of the counters in a numeral series connecting dates, as for

example, on plates 61 and 69. These, which have been heretofore alluded to, are precisely of the form found in the inscriptions. The series as given on plate 69 is 15 katuns, 9 ahaus, 4 chuens, 4 days, the days having a special symbol not joined to that of the chuens. The preceding date is 4 Ahau 8 Cumhu, and that which follows 9 Kan 12 Kayab. The reckoning in this case reaches, as has been shown, the day and day number (9 Kan), but the 7th day of Cumhu instead of the 12th of Kayab. Nevertheless, there can be no question that this is a series precisely after the form of those given in the inscriptions.

In these two series are also seen the ahau and chuen symbols of the usual forms, the days, as has been stated, usually having a separate symbol, generally the so-called kin symbol, as the lower character in the symbol of the month Yaxkin.

The ordinary numerals found at the side or top of these symbols are frequently replaced by one or more little ball or cup-shape characters, such as are shown in figure 21. Others of like form attached to other period symbols are shown at A3, B3, and A4, figure 16. In the latter, ordinary numerals are also present. The first (figure 21) is from the upper division of plate 73, and the others are from plate 69. Are these characters numerals? If so, what is the value of each? As they can not together represent in any instance more than 20, and as many as three are found in some instances attached to one symbol, it is evident that, if they are number characters, each must indicate 1, 2, 3, 4, 5, or 6, not more. As the latter three have also ordinary numerals attached, but odd numbers, it may be inferred that the value is 2, 4, or 6. There is, however, other evidence bearing on this question, which is seen in the symbol shown at A3, figure 16. This is certainly the equivalent of the "calendar round" symbol of the inscriptions, and as the largest number of full calendar rounds in the time series immediately below is 5, the value of each of these little characters would seem to be 2. As a chuen symbol in the same connection is followed by the symbol for day in the abstract sense, each having these little characters attached, the evidence in favor of the theory that they are numerals is very strong. In the middle of the lower half of plate 70 a katun symbol is followed by an ahau symbol, each having these little characters attached without other numerals. So far, however, I have been unable to connect dates by means of these counters, if they be such; but this is not decisive, as there are not sufficient recognized data in any case for a fair test.

FIG. 21—Glyph from plate 73, Dresden codex.

On plate 71, second column, near the top, is a face glyph used as an ahau symbol; as positive proof that it is such, it has inserted in it a small ahau symbol of the usual type. There are several other characters in this codex which appear to be used as number symbols,

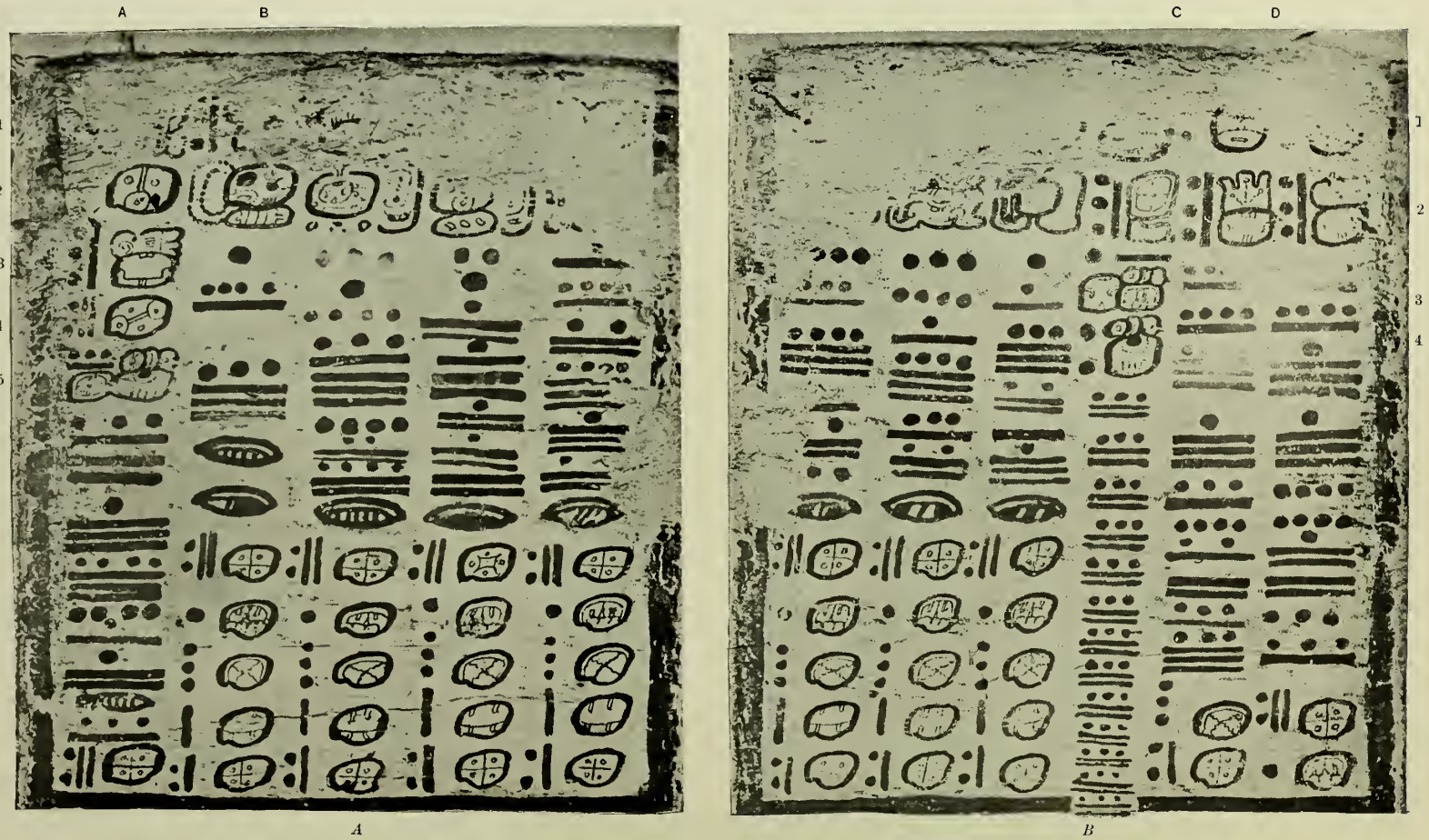
as the bird head with 10 prefixed, center of plate 70; the Imix-like character with 19 prefixed, lower left-hand corner of plate 71.

In regard to this character, which is contained in two groups—one on plate 51, shown at A5, plate XLIV, the other on plate 52, shown at C4, plate XLIV, as given in the codex, Mr Goodman's figures containing supposed restorations—he remarks as follows (p. 93):

> The resemblance between the last glyph in the list and the character occurring on plates 51 and 52 of the Dresden codex removes all doubt of the latter being a directive sign. It is employed so curiously in one instance that it is well worth while giving both examples of its use in order to illustrate the peculiarity. The reckonings it follows are from 4 Ahau 8 Cumhu (which, coincidently, is the beginning of the 54th great cycle of the Archaic era) to 12 Lamat in both cases, but with different intervals. The reading on plate LI is this: [See plate XLIV*a*].
>
> Here the meaning, plainly enough, is: From 4 Ahau 8 Cumhu to the 12 Lamat; that is, 8 days from the former (or initial) date. The reading on plate 52 is more complicated. There are two 4 Ahau–8 Cumhu dates followed by this reckoning: [See plate XLIV*b*].
>
> The 12 Lamat is not distinct, as here, but there can be no question of its identity, the reckoning being of exactly the same character as the other. The reading here is: 4 Ahau 8 Cumhu, 4 Ahau 8 Cumhu, to the 12 Lamat; that is, 8 days, 1 chuen, and 5 ahaus from the 2 former (or initial) dates. The peculiarity here is that the directive sign indicates the reckoning to be from two dates—the only instance of the kind that has come under my observation.

In regard to the group on plate 51 (our plate XLIV) it may be safely assumed that the upper date is 4 Ahau 8 Cumhu, and it is true that counting 8 days from this date brings the reckoning to 12 Lamat, but the long series immediately below seems to be intended to connect the latter date with the 12 Lamat which is below this long series precisely as in the preceding case, the series here ascending to the left. The assumption, therefore, that the Imix symbol is a directive sign is very doubtful; moreover, the Lamat symbol precedes it. Förstemann suggests that it signifies an ahau-katun=8,760 days.

Mr Goodman's interpretation of the group on plate 52 (our plate XLIV), will scarcely stand the test of careful examination. In the first place, the assumption that 12 Lamat stands at the head of the group is not warranted. The remnant of the obliterated glyph gives no color to it, nor is there anything in the arrangement of the series in the division to suggest it. Moreover, the two dates—each 4 Ahau 8 Cumhu—do not pertain to the column, but to the two long series at the right immediately under them. This is evident from inspection, but positive proof is found in the fact that, if we use the black numerals of the series, the 4 Ahau 8 Cumhu over the right column connects with the 12 Lamat below, and when we use the red counters we reach, in the same series, the 1 Akbal below. Using the red counters in the left column and counting from the 4 Ahau 8 Cumhu above, we reach 7 Lamat below. The black numerals of this column, which, as they stand, differ only 10 days from those of the right column, reach Ezanab,



UPPER DIVISION OF PLATES 51 (*A*) AND 52 (*B*), DRESDEN CODEX

but the day number is 9 and not 3, as it should be; a dot over the 10 chuens will, however, make the connection. It is evident, therefore, that Mr Goodman's explanation of the two dots before the Imix-like symbol of the group is only a supposition, and his theory as to the use of this symbol is without convincing support; nevertheless, it is probably a numeral character. Förstemann's suggestion is that it signifies a "katunic cycle," Goodman's calendar round.

It is true that the troublesome question arises, Are we to assume that the glyphs which have been noticed are always to be considered number symbols, wherever found? This would appear to carry the idea of number symbols to the extreme. See, for example, the ahau symbols on plates 72 and 73. To assume this would imply that the various prefixes to these symbols are numeral signs, as Mr Goodman contends, having assigned values to most of the types found on the plates referred to. Possibly he may be right (see page 67 of his work).

FIG. 22—Figures from plate 72, Dresden codex.

A puzzling character found in this codex is the red circle or loop with bowknot on top (figure 22). Whether these are intended as symbols of connection or not, the series connected with them appear in a majority of cases to form links between other series or to join one or more of what we may term side dates not following in the line of the series. They appear, however, in one series to have some other use; at least, as will be seen when the series is noticed, the numerals inclosed appear to be used in a different way from those in other loops.

The first we notice are those in the lower left-hand corner of plate 70. Counters connected with the left loop are 4 (supposed) chuens, 6 days, the latter number being inclosed in the loop. The date below is 4 Ahau 8 Cumhu, and at the top of the long series over the loop is 9 Ix. If we count backward from 4 Ahau 8 Cumhu 4 chuens, 6 days, or 86 days (which does not carry us beyond the commencement of the year), we reach 9 Ix. The numerals connected with the right loop are 10 chuens, 8 days, or 208 days, the date below 4 Ahau 8 Cumhu and the day above 4 Eb. Reckoning backward as before, we reach the 4 Eb above. The rule also holds good for the counters connected with the loops above, near the middle of the same plate, where those of the left loop are 1 ahau, 12 chuens, 6 days, and those of the right 4 ahaus, 10 chuens, 6 days, the date below each being 4 Ahau 8 Cumhu and the day above each 9 Ix.

The reckoning indicated by the series belonging to the loops in the lower left-hand corner of plate 63 is not quite so satisfactory. The series of the left loop is 11 chuens, 15 days, the date above 3 Chicchan 13 Kankin; that of the middle loop 17 days, the date above 13

Akbal 6 Cumhu; that of the right loop 7 (or 2) ahaus, 14 (or 2) chuens, 19 days, the day above 3 Chicchan (or 13 Akbal); the date below each, 4 Ahau 8 Cumhu. Counting the series of the left loop backward, we reach 3 Chicchan 13 Yaxkin. This is correct except as to the month, which in the codex is certainly Kankin. The reckoning in case of the middle loop reaches 13 Akbal 11 Kayab, whereas the month date in the original is 6 Cumhu. The series attached to the right loop has been corrected by the insertion of a red 2 between the ahau and chuen numerals. The long series above has also been corrected, which indicates some material error here. However, the series will not connect with either of the two days above, following or rejecting the correction. Attention is called to the fact that the numerals inclosed in the loops here in each case exceed 13, the highest day number, as the question of the use of the numerals will come up in a series to be noticed.

The series belonging to the red loop on plate 58 (using the original black numerals, there being a correction or different series in red) is 1 ahau, 7 chuens, 11 days; the date below 4 Ahau 8 Cumhu, the nearest date of the long series to the right is 13 Muluc —? Zac. The reckoning backward reaches 13 Muluc 2 Zac. The native correction is a red 12 inserted between the ahau and the chuens. This has probably been inserted to bring the reckoning to the Muluc of the right column above the lower date. The series in the upper division connects with 13 Oc to the right. That in the middle division of plate 43 connects with the 3 Lamat over it. Of the two series in the upper division of plate 31, that of the right loop connects with the date above, but that of the left does not. The series attached to the red loop on plate 24, if we consider the red symbol inside as naught, connects with 1 Ahau 18 Kayab at the right.

The series connected with the thirteeen loops, upper divisions of plates 71–73, appears to be the usual form of most other series of the codex, but in this case the numbers in the loops do not form part of the counters, but denote the day numbers of the days reached, counting forward (from left to right) from 9 Ix (plate 71), with an interval of 2 chuens, 14 days. This series is explained in my Aids to the Study of the Maya Codices (Sixth Ann. Rep. Bur. Eth., pp. 337–338). It may, however, be called a connecting series, as by the numbers in the loops—though they are day numbers and never exceed 13—it is joined to the series concluding in the upper division of plate 71.

It will be observed that in each case except the last the day from which the reckoning is made is 4 Ahau, and when the month is given 4 Ahau 8 Cumhu. It would seem, therefore, that special importance was, for some reason, attached to this date by the people of the country and era when the codex was written. This, it must be admitted, bears somewhat in favor of Dr Seler's and Mr Goodman's idea of the importance of Ahau in the Mayan time count.

In Other Codices

In regard to these it may be stated in brief that in the Cortesian codex plates 31 to 38 contain frequent repetitions of the ahau symbol, used apparently as a counter, ordinary numerals being generally attached. These, however have, in addition to the numerals, other appendages not seen in the inscriptions (at least not in the same form) as, for example, the cross-hatched adjunct seen on plate 34. It is true some of the forms given by Goodman show cross-hatching, and of these the Cortesian character may be an equivalent. On plate 34 in the lower division and elsewhere are symbols (with numerals attached) which apparently occupy the place of days and chuens, or of the first and second orders of units. However, I am unable to determine either their relation to any of the numerous dates on the plate or their use. Mr Goodman gives to the cross-hatching in some instances the value of 9, but in others he uses it as a multiplier, usually as 20×20 (see pp. 100, 101 of his work). Possibly he would decide that these ahau symbols are simply intended to refer to the beginning of the first, third, tenth ahau, etc., according to the number prefixed. I am inclined to believe there can be little doubt that they are counters with the usual value assigned to the ahau, whatever may be their relation to the dates on the plate.

On plate 35, lower division, and possibly elsewhere, is what appears to be a counter in which the chief element is the Cauac character. The ordinary chuen symbol occurs quite frequently on the plates referred to, but never with more than one set of numerals. Other symbols with numerals attached which may possibly be counters are found on the same plates, but I have been unable to test the supposition.

In the Troano codex what appear to be ahau symbols are found on plates 20 to 23, 31, 7* to 10*, and also elsewhere. On the latter two plates are also what appear to be katun symbols. In a few instances these two symbols have numerals attached. Scattered through the codex are quite a number of other symbols with numerals attached, which appear to be counters or number glyphs. On the so-called title-page of this and the Cortesian codices are quite a number of glyphs which I take to be number symbols. Some of these I presume from the form to be chuens, but they are in groups usually with numerals attached, and as in three instances these numerals are 19, I take them to indicate days, and the number of chuen symbols in a group to indicate the number of chuens, as the two numbers attached to the chuen glyphs in the inscriptions indicate the days and chuens. I am also rather inclined to the belief that on this title-page the fourth line of characters from the top denotes ahaus. The red oval symbols below with numerals attached are also probably number glyphs,

but they must indicate days or some higher order of units than chuens, as the numerals in some cases are 19. However, I have not succeeded in finding any relation between these series and accompanying days.

Whether I have succeeded in showing satisfactorily the real discoveries made by Mr Goodman and in indicating clearly their true value must be determined by the use which other workers in this field will make of what has been here presented. That these discoveries have opened up new lines of investigation in regard to the signification of the codices and inscriptions will be admitted. Believing that the advance made thereby may be profitably carried into the study of the codices in connection with Dr Förstemann's discoveries, I have added some suggestions in regard thereto in the hope that other workers in this field may be induced to pursue the subject.

WORKING TABLES.

As an aid to readers I have followed Mr Goodman's example in presenting tables, chiefly after those in his paper, carrying the cycles up to twenty.

Calendar rounds				Calendar rounds			
1	18,980	21	398,580	41	778,180	61	1,157,780
2	37,960	22	417,560	42	797,160	62	1,176,760
3	56,940	23	436,540	43	816,140	63	1,195,740
4	75,920	24	455,520	44	835,120	64	1,214,720
5	94,900	25	474,500	45	854,100	65	1,233,700
6	113,880	26	493,480	46	873,080	66	1,252,680
7	132,860	27	512,460	47	892,060	67	1,271,660
8	151,840	28	531,440	48	911,040	68	1,290,640
9	170,820	29	550,420	49	930,020	69	1,309,620
10	189,800	30	569,400	50	949,000	70	1,328,600
11	208,780	31	588,380	51	967,980	71	1,347,580
12	227,760	32	607,360	52	986,960	72	1,366,560
13	246,740	33	626,340	53	1,005,940	73	1,385,540
14	265,720	34	645,320	54	1,024,920	74	1,404,520
15	284,700	35	664,300	55	1,043,900	75	1,423,500
16	303,680	36	683,280	56	1,062,880	76	1,442,480
17	322,660	37	702,260	57	1,081,860	77	1,461,460
18	341,640	38	721,240	58	1,100,840	78	1,430,440
19	360,620	39	740,220	59	1,119,820	79	1,499,420
20	379,600	40	759,200	60	1,138,800	80	1,518,400

Ahaus		Katuns		Cycles	
1	360	1	7,200	1	144,000
2	720	2	14,400	2	288,000
3	1,080	3	21,600	3	432,000
4	1,440	4	28,800	4	576,000
5	1,800	5	36,000	5	720,000
6	2,160	6	43,200	6	864,000
7	2,520	7	50,400	7	1,008,000
8	2,880	8	57,600	8	1,152,000
9	3,240	9	64,800	9	1,296,000
10	3,600	10	72,000	10	1,440,000
11	3,960	11	79,200	11	1,584,000
12	4,320	12	86,400	12	1,728,000
13	4,680	13	93,600	13	1,872,000
14	5,040	14	100,800	14	2,016,000
15	5,400	15	108,000	15	2,160,000
16	5,760	16	115,200	16	2,304,000
17	6,120	17	122,400	17	2,448,000
18	6,480	18	129,600	18	2,592,000
19	6,840	19	136,800	19	2,736,000
20	7,200	20	144,000	20	2,880,000